CHAPTER

7

HARD DRIVE INSTALLATION AND SUPPORT

In this chapter, you will learn:

- How to install a hard drive
- How to use diagnostic software
- How to recover lost data on hard drives
- How to apply hard drive troubleshooting skills

This chapter extends the discussion of hard drives in Chapter 6 to explain how to install a new hard drive and use software utility packages to help in managing a hard drive. The chapter addresses what to do when a hard drive fails or shows clear signs of impending disaster, or when data is lost. You will learn how important it is to keep good backups of software and data stored on your hard drive as well as backups of the partition table, boot record, root directory, and FAT. No amount of experience replacing a defective hard drive can substitute for good backups. The data itself is often the most valuable thing in your computer case.

As an additional resource for understanding how information is stored on a hard drive, see Appendix F, "Behind the Scenes with DEBUG," where you can use DEBUG to closely examine a hard drive. DEBUG is a DOS utility that lets you examine memory and hexidecimal data on a hard drive or floppy drive, including the boot record, FAT, and directories.

Installing a Hard Drive

Hard drive installation is much easier now than it was a few years ago. Drives today come already low-level formatted with optimum interleave already established. (**Interleave** is a method of reorganizing sectors in a track to speed up data access.) When older technologies such as MFM and RLL drives were popular a few years ago, to install a hard drive, you had to purchase a controller that conformed to your type of drive. You then low-level formatted the drive, using either a format program stored in the controller BIOS or another utility such as SpinRite. During the low-level format, the software examined your drive, recommended the optimum interleave, and then changed the interleave to the optimum value. As explained in the last chapter, today's IDE drives are low-level formatted at the factory. Now you should low-level format a hard drive only as a last resort, using a specific low-level format program recommended by the manufacturer to refurbish a failing drive unless you have a SCSI drive and the manufacturer recommends you do a low-level format. This chapter will focus on today's IDE and SCSI hard drives.

Installation of IDE and SCSI hard drives includes:

- Installing the hardware and setting jumpers and DIP switches on the drive
- Informing CMOS setup of the new drive
- Creating one or more partitions on the drive
- High-level formatting the drive partitions
- Installing the OS and other software

Physical Installation of IDE or SCSI Hard Drives

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To install an IDE drive, you need the drive, a 40-pin data cable, and perhaps a kit to make the drive fit into a much larger bay. If the system board does not provide an IDE connection, you also need an adapter card.

To install a SCSI drive, you need the drive, a cable compatible with the host adapter you are using, possibly an external terminator if the drive is on the end of the daisy chain, a host adapter if you don't already have one, and perhaps a kit to make the drive fit the bay.

Installing an IDE Hard Drive

Recall from the last chapter that IDE hard drives used today follow the EIDE standard that supports up to four IDE devices on the same system. These devices can be hard drives, CD-ROM drives, tape drives, Zip drives, or other drives that follow the EIDE standards of communication. There are four possible setups for each device:

- Primary IDE channel, master device
- Primary IDE channel, slave device
- Secondary IDE channel, master device
- Secondary IDE channel, slave device

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When planning your system configuration, place the fastest devices on the primary channel and the slower devices on the secondary channel. If possible, allow the fastest hard drive to be your boot device and the only device on the primary channel.

The first step in any installation is to take some precautions. First, make sure that you have a good bootable disk or Windows 9x rescue disk; test it to make sure it works. As always, just in case you lose setup information in the process, make sure you have a record of your CMOS setup on a disk. The next step requires self-discipline. Before you take anything apart, carefully read all the documentation for the drive and adapter card, and the part of your PC documentation that covers hard drive installation. Look for problems you have not considered, such as IRQ or DMA conflicts if this is a second hard drive for your system, or an older, limited version of system BIOS. Also check the setup of your computer to be sure it accommodates the size and type of hard drive you want to install. If you plan to choose a user-defined drive type in the setup (where you must enter the drive specifications), make sure your PC accepts the values you want. Your PC documentation or system setup will provide this information. If your PC does not accommodate a large-capacity drive, you have three choices. You can upgrade your ROM BIOS before changing the drive, use only a part of the large-capacity drive by defining it as a smaller drive type in setup, or install a special adapter card to provide the BIOS you need.

Make sure that you can visualize the entire installation. If you have any questions, find answers to them before you begin. Either keep reading until you locate the answer, call technical support, or ask a knowledgeable friend. You may discover that what you are installing will not work on your computer, but that is better than coping with hours of frustration and a disabled computer. You can't always anticipate every problem, but at least you can know that you made your best effort to understand everything in advance. What you learn in thorough preparation pays off every time!

Having read the documentation for the hard drive, you should understand the meaning of each DIP switch or jumper on the drive. Then you can set the jumpers and DIP switches. For an IDE drive, note that the settings are usually correct for the drive to be the single drive on a system. Before you change any settings, write down the original ones. If things go wrong, you can revert to the original settings and begin again.

Although the settings on the drive can be configured by DIP switches, most settings use jumpers. Each drive type can have a different jumper configuration. Often a description of the jumper settings is printed on the top of the hard drive housing (see Figure 7-1). If they are not, see the documentation or visit the Web site of the drive manufacturer. (One end-of-chapter exercise allows you to practice this.) A typical jumper arrangement is shown in Figure 7-2. The three choices for jumper settings for this drive are listed in Table 7-1. Note that your hard drive might not have the first configuration as an option, but it should have a way of indicating if the drive will be the master device.

Some hard drives have a cable select configuration option. If you choose this configuration, you must use a cable-select data cable. When you use one of these cables, the drive nearest the system board is the master and the drive farthest from the system board is the slave. You can recognize a cable select cable by a small hole somewhere in the data cable.

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TIP

CMOS setup determines which logical drive startup BIOS looks to first for the OS. Either the master IDE drive, the slave IDE drive, or a SCSI device can be a system's boot device. In fact, some systems allow a SCSI drive to be the boot device even when an IDE drive is present.

Table 7-1 Jumper settings on an IDE hard drive

Configuration	Description
Single-drive configuration	This is the only hard drive on this IDE channel. (This is the standard setting)
Master-drive configuration	This is the first of two drives; it most likely is the boot device
Slave-drive configuration	This is the second drive using this channel or data cable
Cable-select configuration	The cable select data cable determines which of the two drives is the master and which is the slave

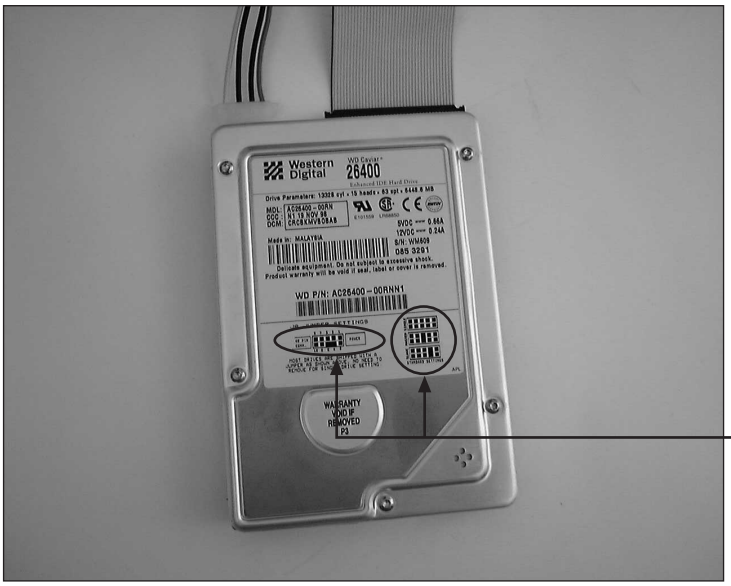

Figure 7-1 An IDE drive most likely will have diagrams of jumper settings for master and slave options printed on the drive housing

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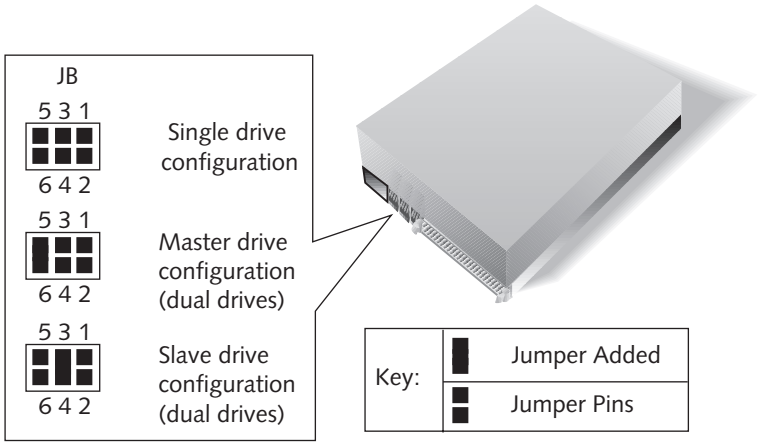

Figure 7-2 Jumper settings on a hard drive and their meanings

The next step is to prepare a large, well-lit place to work. Set out your tools, documentation, new hardware, and notebook. Remember the basic rules concerning static electricity. Ground yourself and the computer. Avoid working on carpet in the winter, when there's a lot of static electricity. Some added precautions for working with hard drives are:

- Handle the drive carefully.
- Do not touch any exposed circuitry or chips.
- Prevent other people from touching exposed microchips on the drive.
- When you first take the drive out of the static-protective package, touch the package containing the drive to a screw holding an expansion card or cover, or to a metal part of the computer case, for at least two seconds. This will drain the static electricity from the package and from your body.
- If you must set down the drive outside the static-protective package, place it component-side up on top of the static-protective package on a flat surface.
- Do not place the drive on the computer case cover or on a metal table.

Verify the state of the computer before you turn it off. Know where your starting point is. Does everything work that's supposed to work?

Verify which of your system's devices are working before installing a new one. Later, if a resource conflict occurs and causes a device to malfunction, the information will help you isolate the problem.

Turn off the computer and unplug it. Unplug the monitor and move it to one side. Remove the computer case cover. Check that you have an available power cord from the power supply.

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If you are using an adapter card, decide which expansion slot you will use for the adapter card. Don't use the one nearest to the power supply unless it's your only choice; heat can shorten the life of any card. Check that the cable you are using reaches from the drive to the adapter card. If it doesn't, you may need to use a different expansion slot. Next check that the wire that controls the drive light on the front of the computer case reaches from the adapter card to the front of the case or to where the connection for the wire is located on the system board. My experience has been that this wire often does not reach as far as it should. Either get a new wire or just don't use the drive light. Locate the pins on the system board for the wire. Use your system board manual to help you locate these pins.

For most installations, instead of using an adapter card, you use an IDE connection on the system board. If you are using an IDE connection on the system board (see Figure 7-3), use the primary IDE connection (sometimes labeled IDE1) before you use the secondary IDE connection (sometimes labeled IDE2). Find the connection and make certain the data cable reaches from the drive bay to the connection.

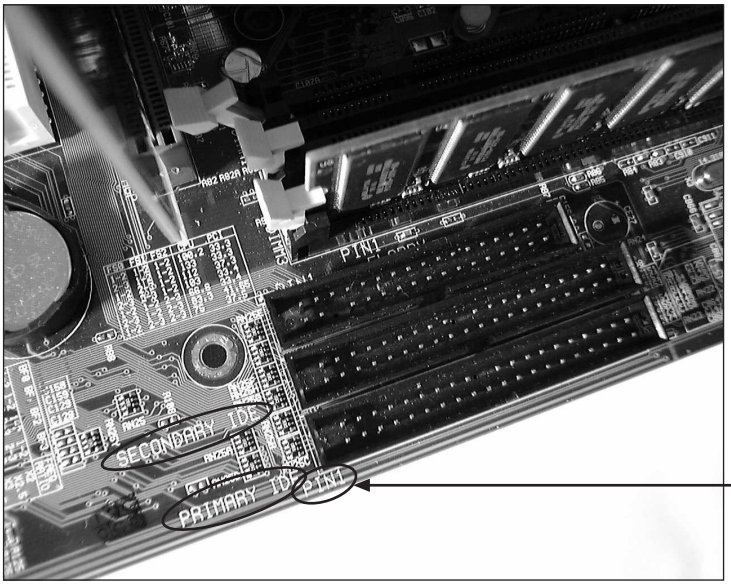

Figure 7-3 Two IDE connections on a system board, primary and secondary

Next look at the drive bay that you will use for the drive. You must be able to securely mount the drive in the bay; drive should not move when it is screwed down. Line up the drive and bay screw holes and make sure everything will fit. If the bay is too large for the drive, a universal bay kit can help you securely fit the drive into the bay. These kits are inexpensive and should create a tailor-made fit. In Figure 7-4 you can see how the universal bay kit adapter works. The adapter spans the distance between the sides of the drive and the bay.

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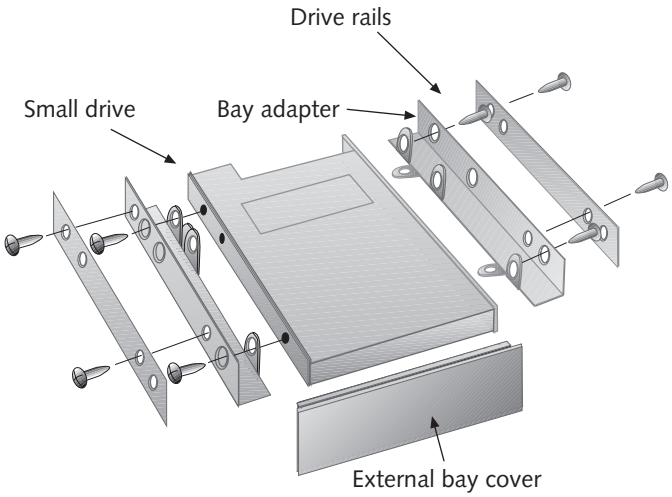

Figure 7-4 Use a universal bay kit to make the drive fit the bay

Do not allow torque to stress the drive. For example, don't force a drive into a space that is too small for it. Also, placing two screws in diagonal positions across the drive can place pressure diagonally on the drive.

For tower cases, the drive can be positioned either horizontally or vertically. External bays can require a bay cover in the front of the tower, while internal bays do not (see Figure 7-5).

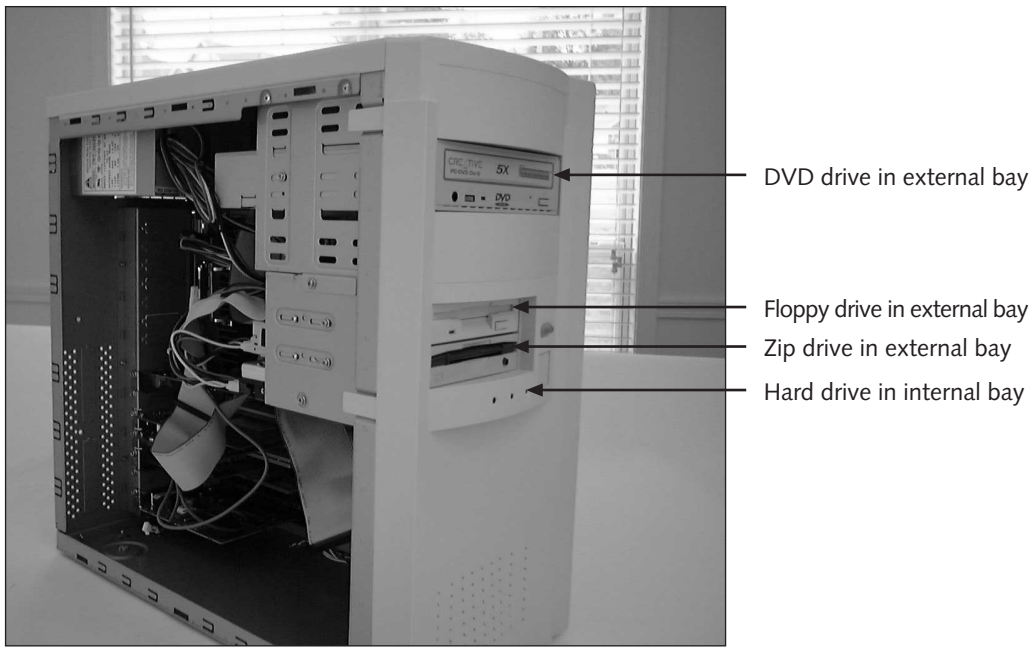

Figure 7-5 A tower case may have internal or external bays

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Be sure the screws are not too long. If they are, you can screw too far into the drive housing and damage the drive itself. After checking the position of the drive and determining how screws are placed, mount the drive in the bay. Decide whether to connect the data cable and power cord to the drive before or after you screw it down, depending on how accessible the connections are.

Once the drive is in place, if you are using an adapter card, insert the adapter card in the expansion slot, being careful not to touch the gold contact fingers on the edge connectors. Use one screw to secure the card to the case at the expansion slot. Don't eliminate this screw—without it cards can work themselves loose over time. Be certain to place the card securely in the slot. The most common error beginners make is not seating the card properly (see Figure 7-6).

Next, connect the data cable, making certain pin 1 and the edge color on the cable are aligned correctly at both ends of the cable. Connect the power cord to the drive. The cord only goes into the connection one way, so you can't go wrong here.

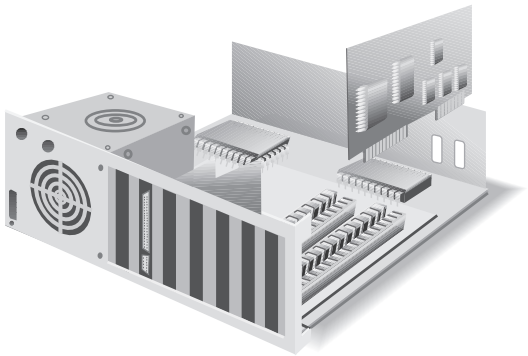

Figure 7-6 Place the adapter card in an expansion slot

When using an adapter card, connect the wire from the adapter card to the front of the case. This wire controls the hard drive activity light on the front of the case. When using a system-board connection, connect the wire from the computer case to the system board. If you reverse the polarity of the LED wire to the drive light at the front of the case, the light might not work. Unless the screw holes in the drive do not align with the screw holes in the bay, or there is some other unusual situation, physical installations go rather quickly.

If the drive light does not work after installing a new drive, try reversing the LED wire on the system board pins.

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Before you replace the computer case, plug in the monitor and turn on the computer. Verify that your system BIOS can find the drive before you replace the cover. If you have a problem, it will most likely involve a loose cable or adapter card. Here are some things to do and check in this case:

- Turn off the computer and monitor before you do anything inside the case.
- Remove and reattach all drive cables. Check for correct pin 1 orientation.
- Remove and reseat the adapter card.
- Place the adapter card in a different slot.
- Check the jumper or DIP switch settings.
- Inspect the drive for damage such as bent pins on the connection for the cable.
- To determine if the hard drive is spinning, listen to the hard drive or lightly touch the metal drive (with power on).
- Check the cable for frayed edges or other damage.
- Check the installation manual for things you might have overlooked. Look for a section about system setup and carefully follow all directions that apply.

Informing Setup of the New Hard Drive

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The newly installed drive is not available for booting until the installation is complete. If the new drive is the boot device, you must boot the computer from a floppy disk. You are now ready to use setup to tell CMOS the hard drive type you are installing. The text below first discusses setup for drives less than 528 MB, then setup for large-capacity drives, and finally setup when your BIOS does not support your large-capacity drive.

BIOS today offers a setup program that makes configuring hard drives easy. You can choose IDE **Auto Detection** and let the BIOS do the work for you. Recall that for this to work both the BIOS and the hard drive must be built to communicate this information. Figure 7-7 shows the four screens that are typical in setup programs that allow you to change hard drive parameters. In Figure 7-7a, you can see the choice for IDE HDD Auto Detection in the third item in the second column. Select this option then save and exit setup and continue with the installation. Later, after you have rebooted with the new drive detected, you can return to setup, view the selections that it made, and make changes where appropriate.

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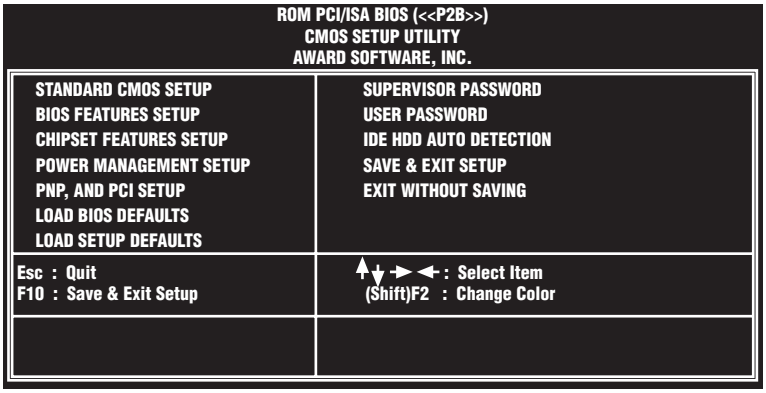
a) CMOS setup utility opening menu



b) Standard CMOS setup

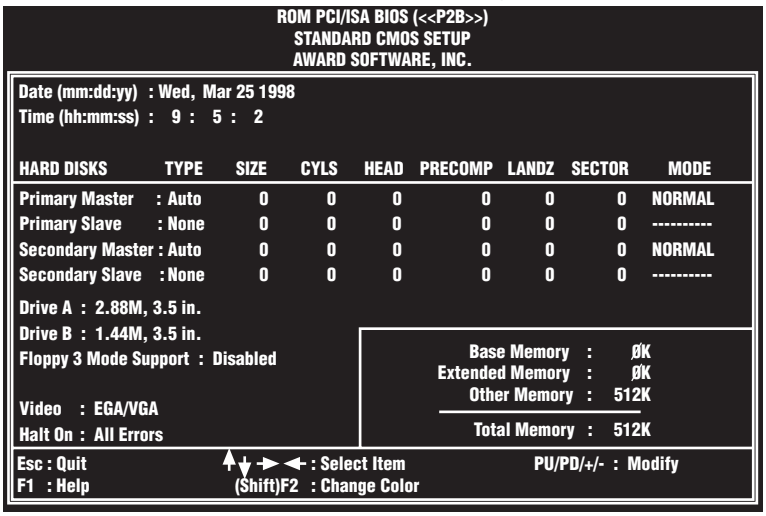


Figure 7-7 CMOS setup screens

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c) CMOS setup for chipset features

```
ROM PCI/ISA BIOS (<<P2B>>)
CHIPSET FEATURES
AWARD SOFTWARE, INC.

SDRAM Configuration          : By SPD
SDRAM CAS Latency            : 2T
SDRAM RAS to CAS Delay       : 3T
SDRAM RAS Precharge Time     : 3T
DRAM Idle Timer              : 16T
SDRAM MA Wait State          : Normal
Snoop Ahead                  : Enabled
Host Bus Fast Data Ready     : Enabled
16-bit I/O Recovery Time     : 1BUSCLK
8-bit I/O Recovery Time      : 1BUSCLK
Graphics Aperture Size       : 64MB
Video.Memory Cache Mode      : UC
PCI 2.1 Support              : Enabled
Memory Hole At 15M-16M       : Disabled
DRAM are 64 (Not 72), bits wide
Data Integrity Mode          : Non-ECC

Onboard FDC Controller       : Enabled
Onboard FDC Swap A & B       : No Swap
Onboard Serial Port 1        : 3F8H/IRQ4
Onboard Serial Port 2        : 2F8H/IRQ3
Onboard Parallel Port        : 378H/IRQ7
Parallel Port Mode           : ECP+EPP
ECP DMA Select               : 3
VART2 Use Infrared           : Disabled
Onboard PCI IDE Enable       : Both
IDE Ultra DMA Mode           : Auto
IDE0 Master PIO/DMA Mode     : Auto
IDE0 Slave  PIO/DMA Mode     : Auto
IDE1 Master PIO/DMA Mode     : Auto
IDE1 Slave  PIO/DMA Mode     : Auto

Esc : Quit                   : Select Item
F1  : Help      PU/PD/+/-    : Modify
F5  : Old Values (Shift)F2   : Color
F6  : Load BIOS Defaults
F7  : Load Setup Defaults
```

d) CMOS setup for BIOS features

```
ROM PCI/ISA BIOS (<<P2B>>)
BIOS FEATURES SETUP
AWARD SOFTWARE, INC.

CPU Internal Core Speed      : 350Mhz

Boot Virus Detection         : Enabled
CPU Level 1 Cache            : Enabled
CPU Level 2 Cache            : Enabled
CPU Level 2 Cache ECC Check  : Disabled
BIOS Update                  : Enabled
Quick Power On Self Test     : Enabled
HDD Sequence SCSI/IDE First  : IDE
Boot Sequence                : A,C
Boot Up Floppy Seek          : Disabled
Floppy Disk Access Control   : R/W
IDE HDD Block Mode Sectors   : HDD MAX
Security Option              : System
PS/2 Mouse Function Control  : Auto
PCI/VGA Palette Snoop        : Disabled
OS/2 Onboard Memory > 64M    : Disabled

Video    ROM BIOS  Shadow    : Enabled
C8000  - CBFFF     Shadow    : Disabled
CC000  - CFFFF     Shadow    : Disabled
D0000  - D3FFF     Shadow    : Disabled
D4000  - D7FFF     Shadow    : Disabled
D8000  - DBFFF     Shadow    : Disabled
DC000  - DFFFF     Shadow    : Disabled

Boot Up NumLock Status       : On
Typematic Rate Setting       : Disabled
Typematic Rate (Chars/Sec)   : 6
Typematic Delay (Msec)       : 250

Esc : Quit                   : Select Item
F1  : Help      PU/PD/+/-    : Modify
F5  : Old Values (Shift)F2   : Color
F6  : Load BIOS Defaults
F7  : Load Setup Defaults
```

Figure 7-7 CMOS setup screens (continued)

Setup for Hard Drives Less Than 528 MB

If you are using an older BIOS that only supports drives less than 528 MB, setup assumes you are using CHS mode, since that was the only available mode when these BIOSs were written. If you are using a newer BIOS, you must select CHS mode or normal mode, usually on the standard CMOS setup screen.

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From this screen, you also enter the logical geometry of the drive. Your computer will probably list appropriate hard drive types and let you select a user-defined type as well. Follow the directions on your setup screen to scroll through the list of drives the BIOS supports. The list is similar to the one in Appendix B. The documentation that came with the hard drive tells you which type to choose, and it also tells you the number of heads and cylinders. The head and cylinder information is often written on the top of the drive housing. If your computer does not offer an exact match, you can enter your own values in the user-defined type.

If your computer does not offer an exact match or a user-defined type, you can improvise. You must choose the correct number of heads, but you can select a smaller number of cylinders than the drive actually has. Choosing fewer cylinders means some cylinders on your drive will remain unused. Choose the number of cylinders closest to the number you actually have without going over.

After you have identified the drive type, save the information to CMOS and reboot your computer from the floppy disk drive to the A prompt. You are now ready to partition the drive. If you see an error at POST when you reboot, turn off the computer and check the drive and card connections. Check the setup to make sure you have chosen the correct drive type.

Setup for Large-Capacity Hard Drives

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Recall from Chapter 6 that the two ways BIOS relates to large capacity drives are LBA and large mode. Notice in Figure 7-7b the column labeled mode, referring to how BIOS relates to the drive. Choices are normal, LBA, large, and auto. Most likely, when auto is the choice, setup will automatically select LBA.

In Figure 7-7c (starting with the 10th item in the second column) you can see the hard drive features that the chip set on this system board supports. They are Ultra DMA, PIO, and DMA modes. Leave all these settings at Auto and let BIOS make the choice according to what it detects your hard drive supports.

In Figure 7-7d, you can see in the 12th item of the first column that BIOS on this system board supports block mode. From this screen you can also select the boot sequence (see ninth item in first column). Choices for this BIOS are A, C; A, CD ROM, C; CD ROM, C, A; D, A; F, A; C only; Zip, C; and C, A. Also notice on this screen (eight item of the first column) that this BIOS supports booting from a SCSI drive even when there is an IDE drive present. Booting from the IDE drive is the default setting.

When BIOS Does Not Support Large-Capacity Hard Drives

If you want to install a large-capacity drive on a PC whose BIOS does not support it, you have the following choices:

- Let the BIOS see the drive as a smaller drive.
- Upgrade the BIOS.
- Upgrade the entire system board.
- Use software that interfaces between the older BIOS and the large-capacity drive.
- Use an adapter card that provides the BIOS to substitute for system BIOS.

A+CORE 1.8

This first option may or may not work, depending on your BIOS. Some BIOSs that do not support large-capacity drives do not recognize a large drive, but simply see the larger hard drive as a smaller drive they can support. In this case, the BIOS assigns a drive capacity smaller than the actual capacity. You can use this method, although it wastes drive space.

Most large-capacity drives come with software that performs the translation between the older BIOS and a large-capacity drive. Examples of this translation or disk overlay software are Disk Manager by OnTrack, SpeedStor by Storage Dimensions, and EZ-Drive by StorageSoft. You can find the software on floppy disk with the drive or download it from the drive manufacturer's Web site. Boot from a floppy disk with the software installed and follow directions on the screen. A small partition or logical drive is created on the hard drive to manage the drive for the older BIOS. It's important to keep this disk in a safe place in case you need it to access the hard drive if the software on the drive becomes corrupted. A disadvantage of using this method is that if you boot from a regular bootable floppy disk, you might not be able to access the hard drive.

Some hard drives come with disk manager software already installed on the drive. For a drive manufactured by Maxtor, the disk manager software is found in a directory called \MAX in a 112-MB partition that BIOS recognizes as drive C. The rest of the drive is assigned to other partitions or logical drives such as drive D or drive E.

Adapter cards are available to provide the BIOS that substitutes for system BIOS. This is the recommended method if your system board does not have an upgrade for system BIOS. One manufacturer of these cards is Promise Technology, Inc.

The best solution is to upgrade BIOS. However, remember that the new BIOS must also relate correctly to the chip set on the system board. Follow the recommendations of the system-board manufacturer when selecting a BIOS upgrade.

A Note on Moving a Hard Drive or Changing BIOS

When you move a large-capacity hard drive from one computer to another, you can lose data. If you use large mode on the first computer and LBA mode on the other, you might not be able to access the drive's data. Also, the translation methods for LBA mode might not be the same from one BIOS to another. For this reason, back up the data on the drive before you move it. If the BIOS on the new computer does not let you access the data on the drive, you can partition and format the drive again and then move the backed-up data onto the newly formatted drive.

Don't change options in setup unless you are sure of what you are doing. You might also lose access to the data on the drive if you have formatted and stored data on a hard drive using one mode and then change to a different mode in setup. Returning to the correct mode might not solve the problem because changing modes can destroy data. To recover access to the hard drive (although data may be lost), repartition and reformat the drive using the correct mode.

Partitioning the Hard Drive

A+ OS 2.1, 3.2

After the hard drive is physically installed and setup knows about the drive, the next step is to partition the drive. Recall that the **partition table** is written at the very beginning of the drive and contains information about the size of each partition and identifies the partition that contains the OS from which the PC boots. Recall also that the partitions are created by the DOS and Windows 9x FDISK setup program.

Before you can use the Windows 9x CD for Windows 9x upgrades, you must first install DOS on the hard drive and boot from it. (You will also need the first Window 3.x setup disk because Window 9x setup asks for it during Window 9x installation.) Insert DOS disk 1 in drive A and boot the computer. FDISK is automatically executed by the install procedure on this disk. Or you can boot from any bootable disk and run FDISK from the disk. In either case, you see the FDISK opening menu shown in Figure 7-8. Select option 1 to create the DOS partition. The menu in Figure 7-9 appears. Use option 1 to create the primary DOS partition. If you plan to install Windows 9x later, be sure this partition is at least 150 MB, preferably more. Make this first partition the active partition. In DOS terms, the active partition is the partition that is used to boot DOS. The active partition will be drive C.

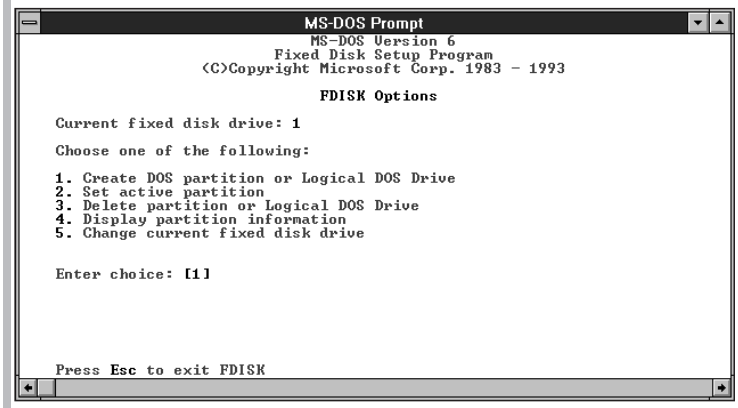

Figure 7-8 Fixed disk setup program (FDISK) menu

Next use option 2 to create an extended DOS partition using the remainder of the hard drive. Then use option 3 to create logical drives in the extended partition. They will be drive D, drive E, and so on.

The non-upgrade version of Windows 9x begins with DOS. The software comes with a DOS bootable disk. Boot from the disk, which prompts you to partition the drive, format it, and provide the necessary DOS files on the hard drive to install Windows 9x.

When FDISK is completed, the hard drive has a partition table, an active and extended partition, and logical drives within these partitions. As seen in Figure 7-8, you can choose option 4 of FDISK to display partition information (see Figure 7-10).

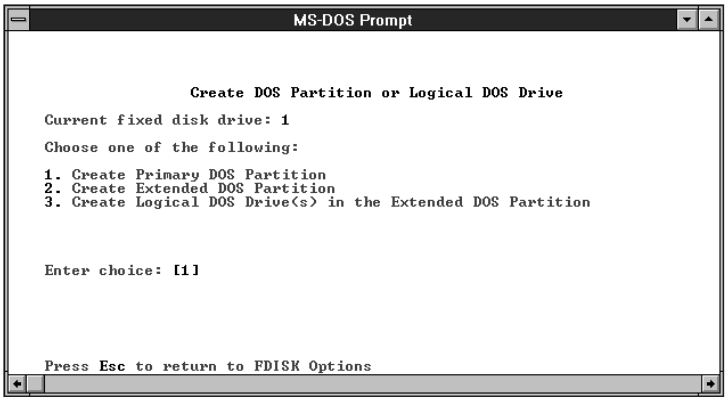

Figure 7-9 FDISK menu to create partitions and logical drives

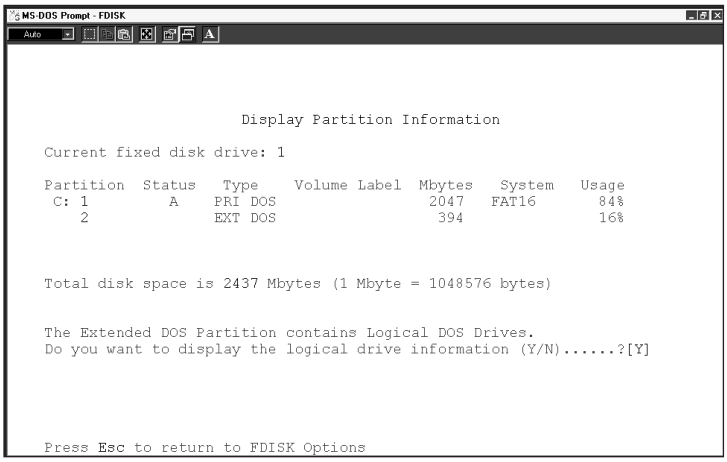

Figure 7-10 FDISK displays partition information

Using More Than One Logical Drive

A+ OS 1.3

DOS and Windows 9x can support only two partitions. The primary partition can hold only one logical drive, the boot device. If you want to have more than one logical drive or volume, create an extended partition and put the other logical drives in it.

Some people prefer to use more than one logical drive to organize their hard drives, especially if they plan to have more than one OS on the same drive. However, the main reason you need multiple logical drives is to optimize space and access time to the drive. Recall from Chapter 6 that, in general, the larger the logical drive, the larger the cluster size, and the more slack or wasted space. When deciding how to allocate space to logical drives, the goal is to use as few logical drives as possible and still keep cluster size to a minimum. You can also use FAT32 for very large drives, which results in an even smaller cluster size for the logical drive size. Table 7-2 gives the information you need to decide how to slice your drive. Recall from

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Chapter 6 that the largest logical drive possible using FAT16 is 2 GB (this limitation is rooted in the largest cluster number that can be stored in a 16-bit FAT entry). However, you can see from the table that, to make a drive that big, the cluster size must be huge. Also, the largest hard drive that FAT16 can support is 8.4 GB; if the drive is larger than that, you must use FAT32.

Table 7-2 Size of some logical drives compared to cluster size for FAT16 and FAT32

File System	Size of Logical Drive	Size of Cluster
FAT16	Up to 128 MB	4 sectors per cluster
	128 to 256 MB	8 sectors per cluster
	256 to 512 MB	16 sectors per cluster
	512 MB to 1 GB	32 sectors per cluster
	1 GB to 2 GB	64 sectors per cluster
FAT32	512 MB to 8 GB	4 sectors per cluster
	8 GB to 16 GB	8 sectors per cluster
	16 GB to 32 GB	16 sectors per cluster
	More than 32 GB	32 sectors per cluster
NTFS	Up to 512 MB	1 sector per cluster
	512 MB to 1 GB	2 sectors per cluster
	More than 1 GB	4 sectors per cluster

Notice from Table 7-2 that the smallest logical drive that FAT32 supports is 512 MB. If you want to create a FAT32 volume using the Windows 9x FDISK program, answer yes when it asks you if you want to "enable large disk support."

After FDISK is done, reboot the system using a system disk or Windows setup CD, and you are now ready to format the drive.

OS or High-Level Format

After the hard drive has been partitioned, an OS must individually format each volume or logical drive within a partition. This is called the **high-level format** or the **operating system format**. The Windows 9x or DOS format writes the **boot record** in the first sector of each volume. Recall that this boot record is sometimes called the DOS boot record (DBR) or OS boot record. DOS or Windows 9x identifies this sector as sector 0 for each logical drive. Following the boot record, the OS creates two copies of the FAT as well as the root directory, just as it does on floppy disks. When the OS creates the FAT, the Format program scans the track and sector markings created by the low-level format of the drive performed by the manufacturer. If the low-level format encounters bad or unusable sectors, it marks these sectors so that the FORMAT program can recognize them as bad. FORMAT marks them in the FAT as bad sectors. The FFF7 entry in the FAT marks an entire cluster as bad so that the drive does not use that area.

For DOS, use this command: FORMAT C:/S. If you include the /S option in the FORMAT command, the program also writes the two hidden files and COMMAND.COM to the drive. The hard drive is now bootable. Use the FORMAT command for each logical drive. For example, for drive D, enter the command FORMAT D:.

For Windows 9x, the Windows 9x CD-ROM contains the real-mode drivers necessary to access the CD-ROM without having Windows installed. Place the Windows 9x Startup disk in the floppy drive and reboot. When you see the message, "Start computer with CD-ROM support," press Enter. The prompt indicates the CD-ROM letter. Insert the Windows 9x CD-ROM in the drive and type "setup" after the CD-ROM drive letter. If the setup process begins, follow the instructions on screen to install Windows 9x.

If you cannot access the Windows 9x CD, then the generic CD-ROM drivers on the Startup disk won't work with your CD-ROM drive. In that case, you must install the CD-ROM drivers before you can install Windows 9x from CD.

To install the drivers for your CD-ROM drive, see the instructions that came with your CD-ROM drive. The drive also comes with a floppy disk that has the drivers on it. Follow the instructions to install these drivers on the hard drive.

Installing Software

After your new hard drive is bootable and you have installed Windows 9x, you are ready to load the applications software, a subject that is addressed in later chapters. Once your drive has software completely loaded and working, there's no better time to make a complete backup of the entire drive—to tape or removable drive—using backup utility software. Also, for DOS, make a bootable disk that contains all the files in the root directory of the drive. This disk will be your emergency disk if you have trouble with the drive later. For Windows 9x, make an emergency startup disk, as discussed in Chapter 2.

Saving the Partition Table to Disk

If you have Nuts & Bolts, Norton Utilities, or other similar software, create a rescue disk to recover from a corrupted partition table. Saving the partition table using Nuts & Bolts and Norton Utilities is covered in the next section. To use DOS to make a copy of the partition table, follow these instructions:

Use the DOS 5 MIRROR command to save the partition table. The command line is:

```
C:\> MIRROR /PARTN
```

Recall that the DOS UNFORMAT command restores the partition table from the disk. Details were given in Chapter 6.

When Things Go Wrong

Sometimes trouble crops up during the installation process. Keeping a cool head, thinking things through carefully a second, third, and fourth time, and using all available resources will most likely get you out of any mess. Installing a hard drive is not difficult unless you have an unusually complex situation.

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For example, your first hard drive installation should not involve installing a second SCSI drive into a system that has two SCSI host adapters. Nor should you install a second drive into a system that uses an IDE connection for one drive on the system board and an adapter

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card in an expansion slot for the other. If a complicated installation is necessary and you have never installed a hard drive, consider asking for expert help. Know your limitations. Start with the simple and build your way up. Using what you have learned in this chapter and in Chapter 6, you should be able to install a single IDE drive in a PC, or install a second slave IDE master drive. After mastering that, tackle something more complicated.

Here are some errors that might occur during a hard drive installation, their causes, and what to do about them. This list has been compiled from experience. Everyone makes mistakes when learning something new, and you probably will, too. You can then add your own experiences to this list.

1. We physically installed an IDE adapter card and IDE hard drive. We turned on the machine and told setup what drive was present. When we rebooted from a disk, we received the following error message:

   ```
   Hard drive not found
   ```

   Although the hard drive was not yet bootable, POST should have found it. We turned off the machine, checked all cables, and discovered the data cable from the card to the drive was not tightly connected. We reseated the cable and rebooted. POST found the drive.

2. We got to the same point as in the previous situation except that we had replaced the cover on the computer case. When we rebooted from a disk, POST beeped three times and stopped.

   Recall that diagnostics during POST are often communicated by beeps if the tests take place before POST has checked video and made it available to display the messages. Three beeps on most computers signal a memory error. We turned the computer off and checked the memory SIMMs on the system board. A SIMM positioned at the edge of the system board next to the cover had been bumped as we replaced the cover. We reseated the SIMM and booted from a floppy disk again, this time with the cover still off. The error disappeared.

3. We physically installed a card and drive and turned on the computer. We received the following error:

   ```
   No boot device available
   ```

   We forgot to insert a bootable disk. We put the disk in the drive and rebooted the machine successfully.

4. We physically installed the card and drive, inserted a floppy disk in the disk drive, and rebooted. We received the following error message:

   ```
   Configuration/CMOS error. Run setup.
   ```

   This error message is normal. POST found a hard drive it was not expecting. The next step is to run setup.

5. We physically installed the card and drive and tried to reboot from a floppy disk. The error message 601 appeared on the screen. Any error message in the 600 range refers to the floppy disk. Because the case cover was still off, we looked at the

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connections and discovered that the power cord to the floppy disk drive was not connected. (It had been disconnected earlier to expose the hard drive bay underneath.) We turned off the machine and plugged the cable in. The error disappeared.

6. The hard drive did not physically fit into the bay. The screw holes did not line up. We got a bay kit, but it just didn't seem to work.

   We took a break, went to lunch, and came back to make a fresh start. We asked others to help view the brackets, holes, and screws from a fresh perspective. It didn't take long to discover the correct position for the brackets in the bay.

7. We physically installed a drive and card after changing jumper settings on the drive. We booted up, changed setup, and rebooted. We received the following error message:

   ```
   Hard drive not present
   ```

   We rechecked all physical connections and found everything was OK. After checking the jumper settings, we realized that we had set them as if this were the second drive of a two-drive system when it was the only drive. We restored the jumpers to their original state. In this case, as in most cases, the jumpers were set at the factory to be correct when the drive is the only drive.

One last warning. When things are not going well, you can tense up and make mistakes more easily. Be certain to avoid one costly error: turn off the machine before doing anything inside. A friend was in this situation once. After trying and retrying to boot for some time, he got frustrated and careless. He plugged the power cord into the drive without turning the PC off. Smoke went up and everything went dead. The next thing he learned was how to replace a power supply!

Calling Technical Support

To make calls to technical support more effective, have as much of the following information as you can available before you call:

- Drive model and description
- Manufacturer and model of your computer
- Exact wording of error message, if any
- Description of the problem
- Hardware and software configuration for your system

Installing a SCSI Hard Drive

Installing a SCSI hard drive is more complicated than installing an ordinary IDE hard drive, but having a SCSI bus on your system allows you to add other SCSI devices, such as a CD-ROM drive or a cassette tape for backups.

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When you install a SCSI hard drive, make sure that your host adapter and the cables you are using are compatible with the SCSI drive. The vendor can help you here. Read the documentation for both the SCSI host adapter and the hard drive before beginning; most SCSI documentation is well written and thorough. In addition to the procedure already discussed for IDE hard drives, a SCSI installation requires that you configure the SCSI host adapter and the SCSI hard drive so that they can communicate with each other. This is done as follows:

1. **Set SCSI IDs.** Set the ID for each device on the SCSI bus. The host adapter documentation will probably explain that the host adapter must be set to ID 7. If the hard drive will be the boot device for the system, its ID is likely to be 0. The second hard drive ID is usually 1**.** These ID settings might be set by jumpers or DIP switches on the drive.

Jumpers on a SCSI device used to set the SCSI ID represent the binary value of the ID. For example, an ID of 6, which is 110 in binary, requires three jumpers set to on, on, and off.

2. **Disable or enable disk drive and hard drive controllers.** If the host adapter has a built-in disk drive controller that you are not using, it might be necessary to disable the controller with jumpers or DIP switches, or from the SCSI software setup program. The host adapter documentation will explain how to do this. Incidentally, if you are not using a hard drive or disk drive controller on your system board, you must disable these controllers by setting jumpers or DIP switches on the system board. See the documentation for your system board. Sometimes CMOS setup gives you the option of booting from the SCSI hard drive even if an IDE hard drive is installed.
3. **Terminating resistors.** Devices on both ends of the bus must have terminating resistors enabled so that the voltages to these devices do not spike from reflected signals at the end of the SCSI bus. The documentation will advise you to use terminating resistors that plug into a socket on the board or device, or to use terminating resistor connections where the cable plugs into the device. Some host adapters have jumper or DIP switches that enable or disable resistors on the card. Again, the documentation will be specific.
4. **CMOS setup for a SCSI system.** After you have physically installed the SCSI host and drive, tell setup that the SCSI system is present. Remember that for SCSI devices, the computer does not communicate with the hard drive directly but interfaces with the SCSI host adapter. To use a SCSI hard drive, some computers require that you tell setup that no hard drive is present. The SCSI host provides that information to the computer during start up. Sometimes, the computer setup lets you choose a SCSI hard drive type. That's all it needs to know, and the SCSI host adapter takes over from there. To recognize a SCSI drive, some computers require that the drive type be set to 1 in setup.
5. **SCSI device drivers.** A SCSI bus system on a computer using DOS is likely to require a SCSI device driver to be loaded in the CONFIG.SYS file of the bootable drive. Windows 9x offers its own SCSI driver, although if the host

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adapter documentation recommends that you use the adapter's driver instead, then do so. As described in Chapter 6, the two well-known device drivers for SCSI systems are ASPI and CAM. After physically installing the drive and changing CMOS setup, the next step in any hard drive installation is to boot from a floppy disk. The hard drive package will include a bootable disk that loads the device driver to access the SCSI system. A SCSI installation disk includes the files necessary to boot to a DOS prompt, and a CONFIG.SYS file that contains the DEVICE= line to load the SCSI driver. The disk also includes the file containing the driver program. (It's a good idea to have more than one bootable disk available. If you have problems, you can boot from the one that doesn't have the SCSI driver on it.) After you have partitioned and formatted the drive, the installation disk will put this same device driver on your hard drive.

The procedure has more steps if the SCSI drive is installed on the same computer with an IDE drive. For this installation, the IDE drive must be the boot drive and the SCSI drive must be the secondary drive unless your system BIOS supports SCSI hard drives. Because the SCSI bus does not contain the boot device, you must communicate the location of the boot drive to the SCSI host adapter. Again, the documentation for the host adapter will explain how to do this. It may tell you to disable the SCSI host adapter BIOS and drive the SCSI bus (no pun intended) with a device driver loaded in the CONFIG.SYS file of the bootable non-SCSI hard drive.

If you have a CD-ROM drive or other device on the SCSI bus, install its device drivers in CONFIG.SYS so the device operates. Place the DEVICE= command for any SCSI device after the DEVICE= command that loads the SCSI host device driver.

Multiple Operating Systems

Sometimes a PC has more than one operating system on a hard drive, which is called dual booting. During the boot process, you decide which OS will load and complete the boot. The OS that controls the logical drive C (or whichever logical drive is specified in CMOS setup) always begins the boot process, because it is the one that BIOS turns to when searching for a boot device. During the boot, the OS on the boot partition offers the user the option of choosing another OS on the drive. Each OS manages a certain portion of the hard drive, which is accomplished by each OS formatting its own logical drive.

For example, you can install DOS with Windows 3.1 and Windows 9x on the same hard drive so that you can use software made for each operating environment within its native OS. To accomplish this dual boot, follow these general procedures:

1. Install DOS 6.x on your hard drive, using the DOS setup disk to partition and format the drive. DOS installs itself in a directory named \DOS.
2. Install Windows 3.x. By default, it installs itself in the \Windows directory.
3. Because Windows 9x deletes some DOS utility programs, back up your \DOS directory to a different directory, using this command:

   ```
   XCOPY C:\DOS\*.* C:\DOSSAVE\*.*
   ```

4. Install Windows 9x. When asked for the directory name, choose a directory name different from the directory in which Windows 3.x is installed, such as \Win9x.
5. Restore your \DOS directory from the backup:

   ```
   XCOPY C:\DOSSAVE\*.* C:\DOS\*.*
   ```

6. Edit the Windows 9x system file MSDOS.SYS in the root directory to allow for a dual boot. To do this, make MSDOS.SYS not hidden, not read-only, and not a system file, using this command:

   ```
   ATTRIB -R -H -S C:\MSDOS.SYS
   ```

7. Now open MSDOS.SYS with any text editor, such as EDIT, and in the [OPTIONS] section, add this line:

   ```
   BootMulti=1
   ```

   This setting allows for a multiboot configuration. Save the file.
8. Reboot your PC. The PC normally boots to Windows 9x. If you want to boot to DOS and Windows 3.x, press **F8** when you see the message that Windows 9x is starting to load. You see a menu. Choose the "a previous version of MS-DOS" option. DOS then loads.

When a PC has both Windows 9x and DOS, a problem may occur because both OSs have files that have the same name but different purposes and contents. Windows 9x manages this potential conflict by renaming DOS files when it is installed.

When you halt the Windows 9x boot and reboot to the previous version of MS-DOS, Windows 9x restores the DOS files to the names that DOS expects. Table 7-3 lists the renamed files.

Table 7-3 DOS and Windows 9x files that are renamed by Windows 9x

Name When Windows 9x Is Active	Name When DOS Is Active	This File Belongs to
Autoexec.bat	Autoexec.w40	Windows 9x
AUTOEXEC.DOS	AUTOEXEC.BAT	DOS
Command.com	Command.w40	Windows 9x
COMMAND.DOS	COMMAND.COM	DOS
Config.sys	Config.w40	Windows 9x
CONFIG.DOS	CONFIG.SYS	DOS
IO.sys	Winboot.sys	Windows 9x
IO.DOS	IO.SYS	DOS
Msdos.sys	Msdos.w40	Windows 9x
MSDOS.DOS	MSDOS.SYS	DOS

Troubleshooting Hard Drives and Data Recovery

The rest of this chapter focuses on solving problems with hard drives and recovering corrupted data. We first take a quick look at four popular diagnostic and recovery software programs: Nuts & Bolts, Norton Utilities, Partition Magic, and SpinRite. Next we examine in detail what can go wrong with a hard drive and what to do about it. Special attention is given to recovering data lost through hard drive problems. Finally, a section on general troubleshooting guidelines summarizes much of the material in this section.

An Ounce of Prevention

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Taking good care of your hard drive is not difficult, but it does require a little time. Before we begin a discussion of hard drive troubleshooting and data recovery, here are some precautions you can take to protect your data and software as well as the drive itself.

- **Make backups and keep them current.** It's worth saying again: keep backups. Never trust a computer; it'll let you down. Make a backup of your hard drive partition table, boot record, and CMOS setup. Whenever you install a new software package, back it up to disks or tape. Keep data files in directories separate from the software, to make backing up data easier. Back up the data as often as every four hours of data entry. Rotate the backup disks or tapes by keeping the last two or three most recent backups.
- **Defragment files and scan the hard drive occasionally.** A fragmented hard drive increases access time, and reading and writing files wears out the drive. If you are trying to salvage a damaged file, it is much more difficult to recover a fragmented file than one stored in contiguous clusters. Regularly scan your hard drive for **lost** or **cross-linked clusters**.
- **Don't smoke around your hard drive.** To a read/write head, a particle of smoke on a hard drive platter is like a boulder with a 10-foot circumference on the highway. Hard drives are not airtight. One study showed that smoking near a computer reduced the average life span of a hard drive by 25%.
- **Don't leave the PC turned off for weeks or months at a time.** Once my daughter left her PC turned off for an entire summer. At the beginning of the new school term, the PC would not boot. We discovered that the master boot record had become corrupted. PCs are like cars in this respect: long spans of inactivity can cause problems.
- **High humidity can be dangerous for hard drives.** High humidity is not good for hard drives. I once worked in a basement with PCs, and hard drives failed much too often. After we installed dehumidifiers, the hard drives became more reliable.
- **Be gentle with a hard drive.** Don't bump the PC or move it when the drive is spinning.

Utility Software

This section examines four popular **utility software** programs: Nuts & Bolts, Norton Utilities, SpinRite, and Partition Magic. The following descriptions tell you what to expect from the software with regard to recovery from a hard drive failure (note that this is *not* a complete listing of all the software's functions). You can find detailed instructions for performing the operations discussed here in the documentation for the software.

Nuts & Bolts

Nuts & Bolts by Network Associates, Inc., and McAfee are made up of four suites: Repair and Recover, Clean and Optimize, Prevent and Protect, and Secure and Manage. This limited discussion of recovering from a hard drive failure looks at only four of the 25 utilities in the suites:

- **Disk Minder** diagnoses and repairs hard drive problems, including those in the partition table, boot record, FAT, files, and directories.
- **Image** creates an image of critical disk information, which is written to a file on the hard drive to be used later if the disk is corrupted.
- **Rescue Disk** creates a disk from which you can boot and begin the recovery process if you can't start the system from the hard drive.
- **Disk Tune** defragments hard drives, consolidates free space, and reorganizes all files on the drive for optimal performance.

Figure 7-11 shows the main menu of Nuts & Bolts together with WinGauge, part of the Prevent and Protect feature, which continually monitors the system for conditions that may lead to problems (including applications software crashes).

The following is a look at the four utilities listed above.

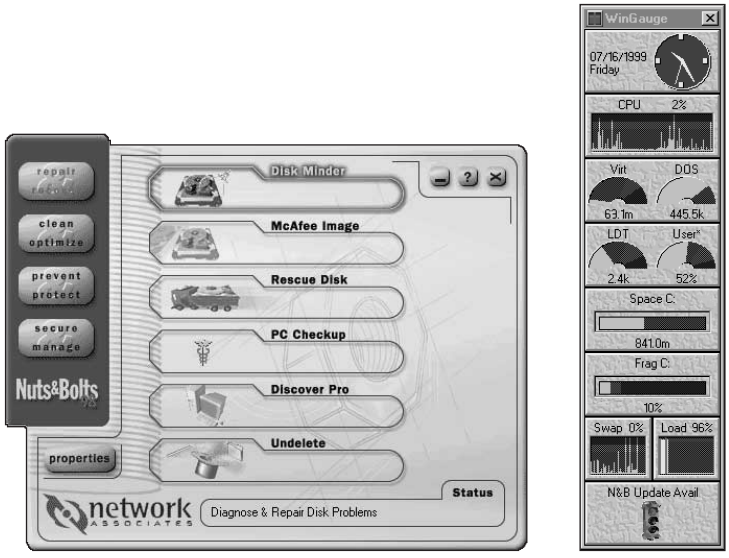

Figure 7-11 Nuts & Bolts main menu showing Repair and Recover submenu options

Disk Minder From the main menu of Nuts & Bolts shown in Figure 7-11, first select **Repair and Recover** on the left and then click **Disk Minder** on the Repair and Recover submenu to access this feature of the software. Click **Properties** to display the Properties dialog box in Figure 7-12, listing some of the things that Disk Minder will check.

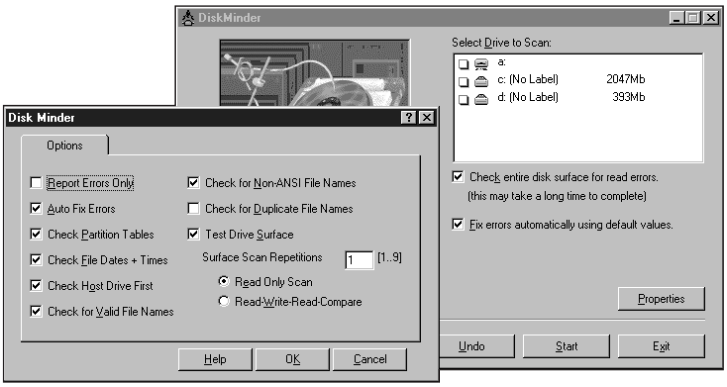

Figure 7-12 Nuts & Bolts Disk Minder scans drive for errors and can automatically repair them

Disk Minder includes the same functions as does Windows ScanDisk plus additional features, and is faster than ScanDisk. Disk Minder can check and correct problems with the partition table, boot sector, FAT, disk compression structure, directories, filenames, file dates and times, and clusters.

This version of Disk Minder is run under Windows 98, Windows 95, or Windows 3.x, but Disk Minder for DOS is also included in the software, in the event that you cannot boot from the hard drive. Look for directions below under the section "Rescue Disk." After you have recovered the hard drive so that you can boot from it again, use Disk Minder for Windows to complete the recovery process.

Image Select McAfee **Image** to create a snapshot of critical sectors of the hard drive and store this information on the hard drive in a .DAT file. You can set Image so that it takes this snapshot each time you boot. In case of a hard drive crash or destruction caused by a virus or other catastrophe, use Image to restore the directories and FAT to their state when the last snapshot was taken. Use Image frequently so that your snapshot will be current if it is needed. When you select Image from the Nuts & Bolts main menu, the Image dialog box appears. Click **Properties** to see the dialog box in Figure 7-13. From this Image Properties dialog box, you can choose to have Image take a snapshot of the hard drive every time the PC is booted.

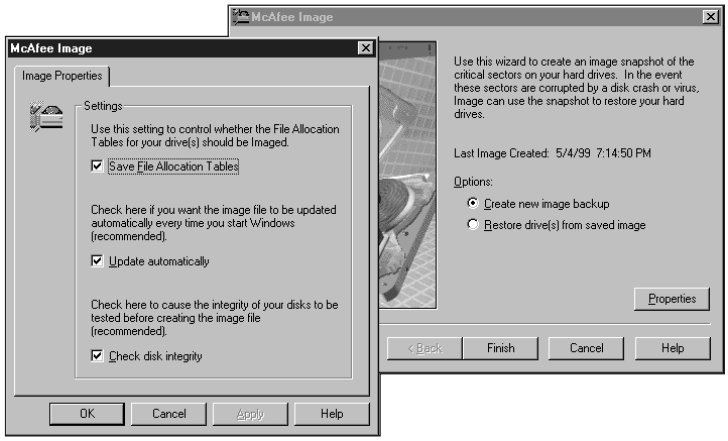

Figure 7-13 The Image Properties dialog box shows how to have Nuts & Bolts take a snapshot of critical areas of the hard drive each time Windows is loaded

When you select **Restore drive from saved image** from the Image dialog box, you see the dialog box in Figure 7-14, listing files in the root directory that contain snapshots of the hard drive that Image has previously taken. By default, Image stores these files in the root directory. Select the image file that you want to use for the recovery.

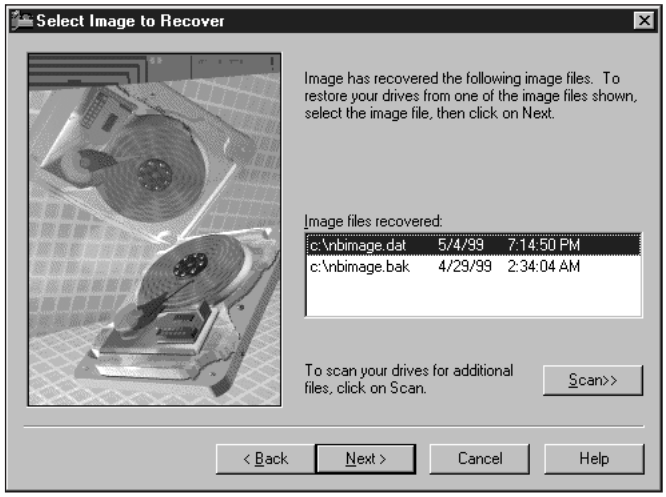

Figure 7-14 Nuts & Bolts Image creates the snapshot files in the root directory of the hard drive

Click **Next**, and the dialog box in Figure 7-15 appears, allowing you to select which areas of the hard drive to restore. Do no select the file allocation tables if many changes have been made to the file structure on the hard drive since the last snapshot was made. Use Disk Minder instead. However, the master boot sector and the partition table information should

not have changed since the drive was last partitioned and formatted or drive compression was implemented. Click **Finish** to restore the selected areas of the drive. The Image restore process can also be implemented from the Nuts & Bolts rescue disk. Nuts & Bolts writes the Image snapshot file to the drive in such a way that it can read the file even from a drive that is severely damaged.

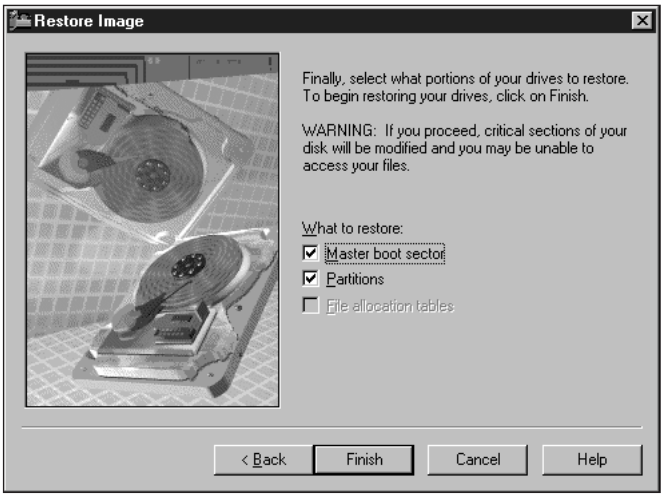

Figure 7-15 What Nuts & Bolts Image can restore on a damaged hard drive

Rescue Disk Create a rescue disk you can use when you cannot boot from the hard drive. When you see the opening dialog box of the Rescue Disk utility, click **Next**, and then click **Advanced** to see the files that the utility will write to the disk, as shown in Figure 7-16. You can add other files to the list or remove files from the list. Click **OK** to return to the opening dialog box, and click **Next** to complete the process.

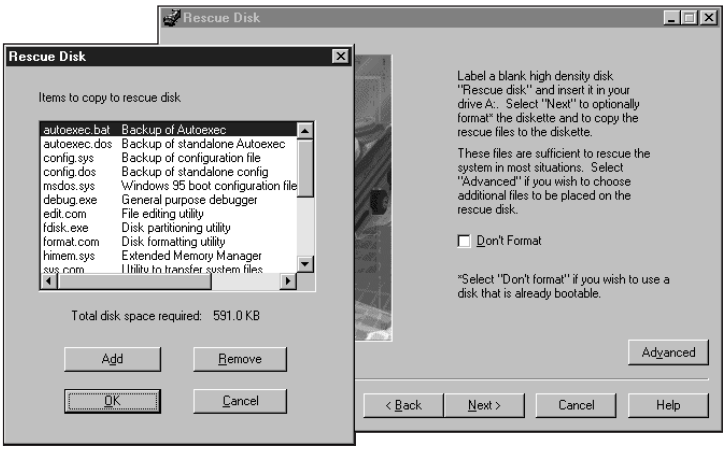

Figure 7-16 Items Nuts & Bolts stores on a rescue disk

When you cannot boot from the hard drive, boot from the rescue disk. After booting, the screen in Figure 7-17 appears, asking if the rescue disk was created on your system or on another PC. If the rescue disk was not created on your current PC, Nuts & Bolts can still be effective in recovering the drive. In either case, Nuts & Bolts examines the drive and then display the menu in Figure 7-18. From this you can use the DOS versions of Disk Minder, Image/Restore, and SysRecover to repair the drive.

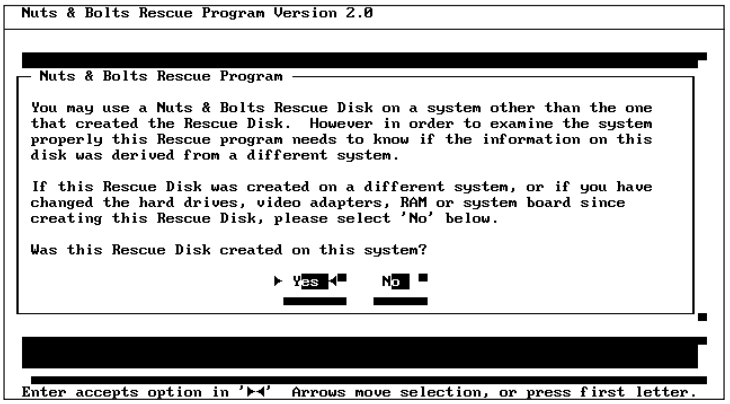

Figure 7-17 Using the Nuts & Bolts rescue disk

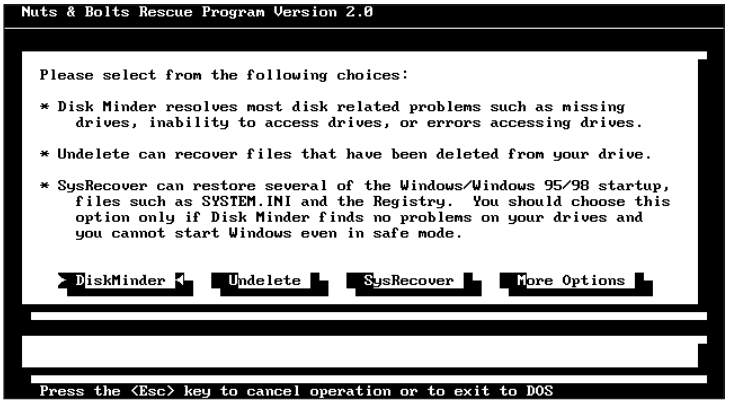

Figure 7-18 Utilities available on the Nuts & Bolts rescue disk

Disk Tune Disk Tune optimizes a hard drive by defragmenting it and moving files so that the most frequently used files are written near the beginning of the drive where access time is fastest. Free space is moved to the end of the drive. While Disk Tune is working, you can watch the progress as the color-coded grid changes color as clusters are read, written, moved, and optimized. Disk Tune can also set all unused FAT entries to zero, but this makes it impossible to use typical recovery procedures to recover deleted files. We will discuss this again later in the chapter.

To use Disk Tune, select **Clean and Optimize** from the Nuts & Bolts main menu, and then click **Disk Tune**. You see the dialog box in Figure 7-19 where you can select the drive to tune. Click **Next**, and the dialog box in Figure 7-20 appears, showing a map of the drive. Click any block to display the cluster numbers and contents of the block. Select the method for Disk Tune to use to optimize your drive, and then click **Start**. Don't use the drive or turn off the PC until the process is completed.

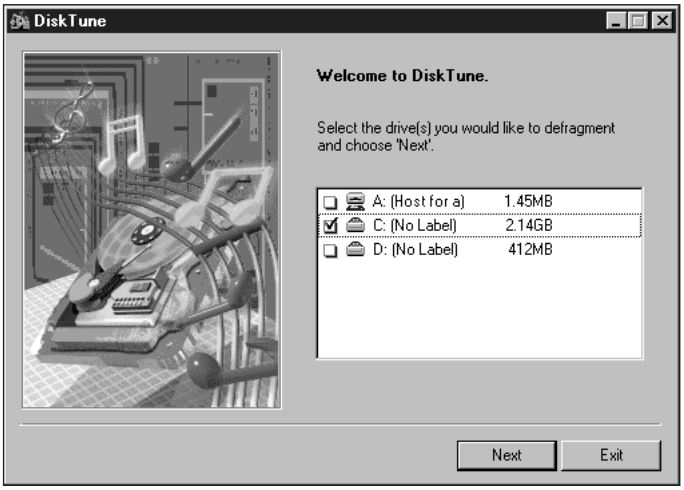

Figure 7-19 Nuts & Bolts Disk Tune lets you defragment and reorganize files on a hard drive

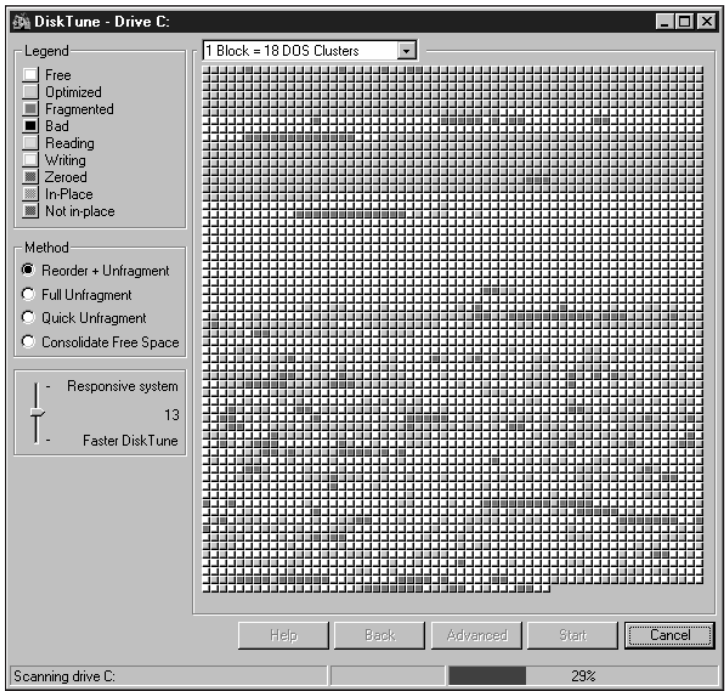

Figure 7-20 The color-coded grid of Disk Tune lets you visually inspect the drive to see how fragmented it is and watch as Disk Tune optimizes the drive

Norton Utilities

Norton Utilities offers several easy-to-use tools to recover data, resurrect a damaged hard drive, enhance hard drive speed and performance, and provide security. Figure 7-21 shows all the programs available under the Norton Utility software. Following is an overview of each Norton Utility program with reference to three main functions: prevention of damage, recovery from damage, and increased system performance. The discussion of the Windows 95 version of Norton Utilities below refers to Version 2.0, although other versions offer the same or similar functionality. The intent here is not to review all the features Norton Utilities offers, but simply to view and demonstrate some techniques to repair the disk and hard drive problems discussed later in the chapter.

If you are using Windows 98 and FAT32, be sure to purchase Norton for Windows 98 and FAT32. Don't try to use a version of Norton that does not support FAT32 on a system that uses FAT32. If you are using Windows NT, be sure to use the version that supports Windows NT.

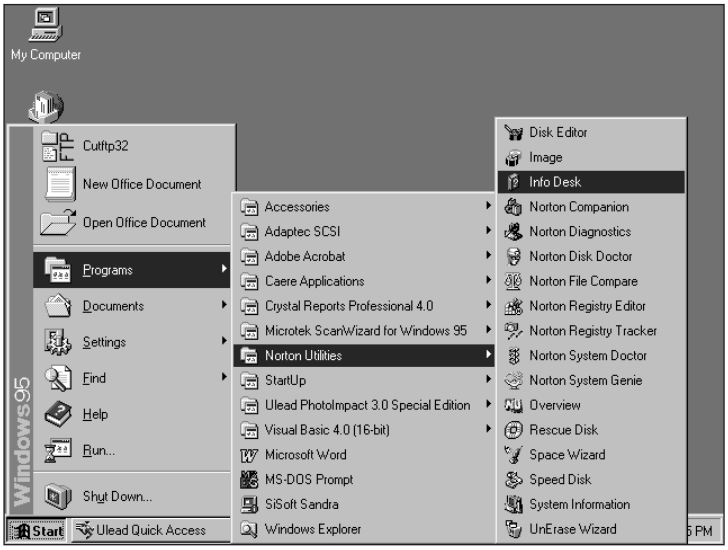

Figure 7-21 The programs of Norton Utilities

Prevention Preparing for problems that might occur later is the key to making the best use of Norton Utilities. Four programs that help you do that are Norton System Doctor, Norton Protection, Rescue Disk, and Image.

- **Norton System Doctor**. Norton System Doctor detects potential disk and system problems and scans for viruses. By default it runs in the background at all times and informs you when it encounters a problem. You determine when Norton System Doctor should react to certain problems and what it should do about them. You can configure it to check the integrity of your hard drive routinely and to open Norton Disk Doctor if it encounters a problem. Figure 7-22 shows some sample alarms produced by Norton System Doctor while running in the background.
- **Norton Protection**. Norton Protection adds an extra layer of protection to the Windows 9x Recycle Bin.
- **Rescue Disk**. Norton Utilities allows you to create a rescue disk set that you can use to recover from hard drive disasters. Once these disks are created, you can use them to:
  - Format a hard drive
  - Make a bootable disk
  - Partition your hard drive using FDISK
  - Recover erased files
  - Recover accidentally formatted disks or heavily damaged disks, including a damaged partition table and boot record
  - Recover damaged files using Disk Editor

- Recover your CMOS setup
- Troubleshoot hardware conflicts using Norton Diagnostics

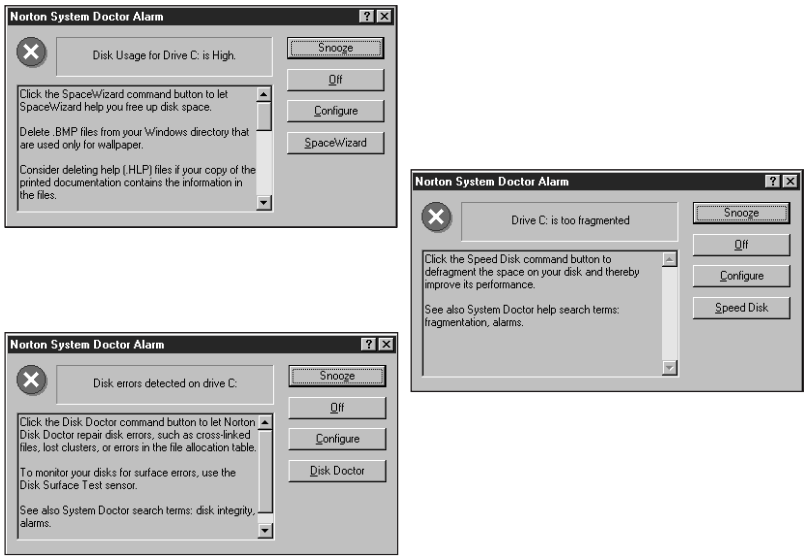

Figure 7-22 Examples of Norton System Doctor alarms

You can configure Norton System Doctor to alert you whenever the rescue disk information becomes out of date.

- **Image**. Image creates a snapshot of disk information, including the boot record, FAT, and root directory information. You can configure Image to record this data each time you boot.

Recovery Norton Utilities offers five programs to help in recovering data and setup information and repairing damaged areas of the hard drive and disks. They are Norton Disk Doctor, UnErase Wizard, Norton Registry Tracker, Norton File Compare, and a DOS program called Disk Editor.

- **Norton Disk Doctor**. Norton Disk Doctor (NDD) automatically repairs many hard disk and floppy disk problems without your intervention. If you ask it to, it creates a backup of the disk before it makes any changes (called the Undo feature). Norton Disk Doctor examines and makes some repairs to the partition table, the DOS boot record, the FAT, directories, and files. It also scans the entire disk, looking for inconsistencies, and diagnoses disk problems, giving you a printed report of the results. If the disk is physically damaged, NDD can mark bad clusters in the FAT so they are not reused. However, Norton Disk Doctor is not a cure-all; some problems are beyond its capabilities.
- **UnErase Wizard**. UnErase Wizard offers added functionality to the Windows 9x Recycle Bin to help recover erased files.

- **Norton Registry Tracker**. Norton Registry Tracker monitors changes to the Windows 9x Registry and allows you to backtrack changes to the Registry.

The Windows 9x Registry is a database the OS uses to store configuration information about the OS environment, user preferences, application software configuration, and hardware configurations.

- **Norton File Compare**. Norton File Compare compares data files as well as Windows 9x Registry and INI files.
- **Disk Editor**. Disk Editor is a powerful tool for editing any part of a disk or hard drive, including the partition table, directory entries, DOS boot record, and FAT. Disk Editor can freely access any portion of the disk. You can reconstruct files manually, sector by sector, and Disk Editor can sometimes read a disk that DOS or Windows 9x refuses to read. Using Disk Editor requires an understanding of how data is stored on a disk, as explained in Chapters 5 and 6.

Performance The four programs designed to improve overall system performance are Norton System Genie, Norton Registry Editor, Speed Disk, and Space Wizard.

- **Norton System Genie**. Norton System Genie allows you to change the way Windows 9x starts up, looks and feels, handles files, and runs applications software.
- **Norton Registry Editor**. Norton Registry Editor is an alternative to the Windows 9x Registry editor, offering improved user interface and functionality.
- **Speed Disk**. Speed Disk is an enhanced disk defragmenter that also allows you to affect the order in which files and folders are written to a disk.
- **Space Wizard**. Space Wizard scans the hard drive for duplicate files, infrequently used files, and temporary files and folders. It then suggests to you files that can be deleted or compressed.

The Help Features of Norton Utilities Norton Utilities offers several ways to access its Help features. One method is direct access to Info Desk. Click **Start**, **Programs**, **Norton Utilities**, **Info Desk** to open the Info Desk window, shown in Figure 7-23. The Index tab works like the index of a book: type characters, and items appear that you can choose to display or print.

Another way to access the Norton Help features is from the utility programs themselves. For example, if you select **Rescue Disk** from the program list in Figure 7-21 to create a new rescue disk set, the Rescue Disk screen appears. From that window, if you click on the Options button, the Norton Rescue Options window appears, as in Figure 7-24. The third item in the list on the rescue disk is Rescue. To find out more about this item, right-click the item. You see the dialog box in Figure 7-25. Select **What's This** for information about the item, select **How To** for step-by-step procedures involving this item, and select **Info Desk** for a direct link to Info Desk and its information about this item. You can also click the **?** in the title bar of each window for general information about the window.

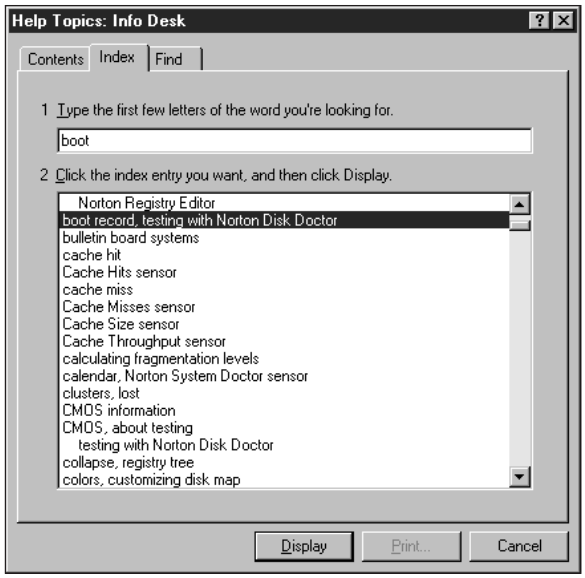

Figure 7-23 One Norton Help utility – Info Desk

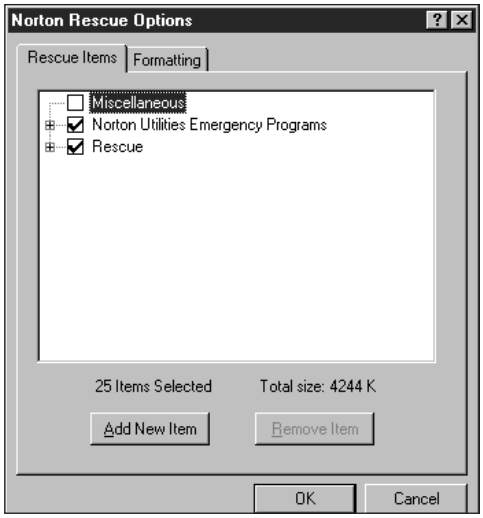

Figure 7-24 Norton Rescue Options

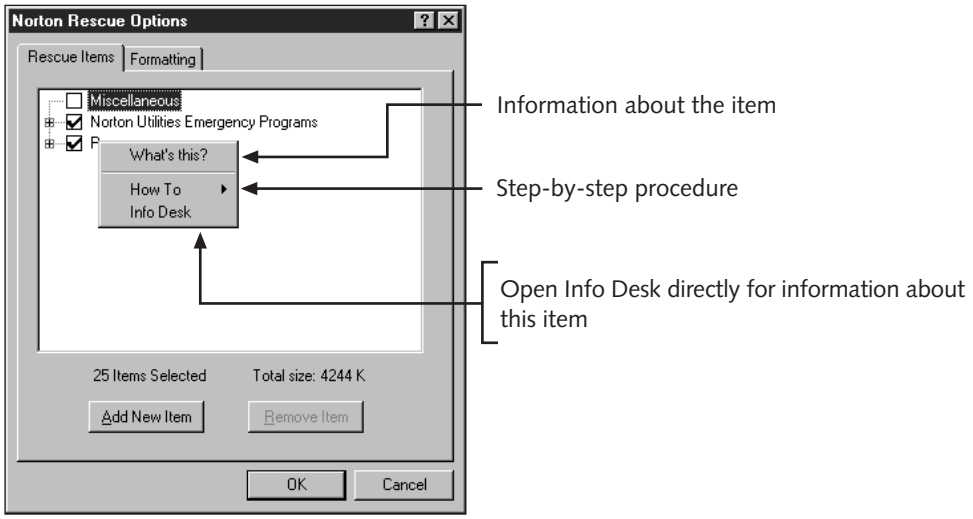

Figure 7-25 To find out more about a Norton Rescue Option, right-click on the item

Viewing the Contents of Norton Utilities Rescue Disk and Creating a Rescue Disk Set To view the contents of Rescue Disk and create a set of rescue disks that contains, among other things, a backup of the hard drive partition table and boot records, follow these directions: Click **Start**, **Programs**, **Norton Utilities**, **Rescue Disk**. When the Rescue Disk opening screen appears, click **Options** (Figure 7-24). Click the + sign to the left of an item to see the list under that item. For example, to see a list of files that will be included on the rescue disks, click the + sign to the left of Rescue. Figure 7-26 shows part of the list. Note that Boot Record is in the list. Further down in the list the partition table is listed. From the Options window, you can include or exclude certain items from the list. When finished, return to the previous window by clicking **OK**. Click **Start** to create the rescue disk.

Partition Magic

Partition Magic by PowerQuest Corporation lets you manage partitions on a hard drive more quickly and easily than with FDISK. You can create new partitions, change the size of partitions, and move partitions without losing data or moving the data to another hard drive while you work. You can switch between FAT16 and FAT32 without disturbing your data, and you can hide and show partitions to secure your data.

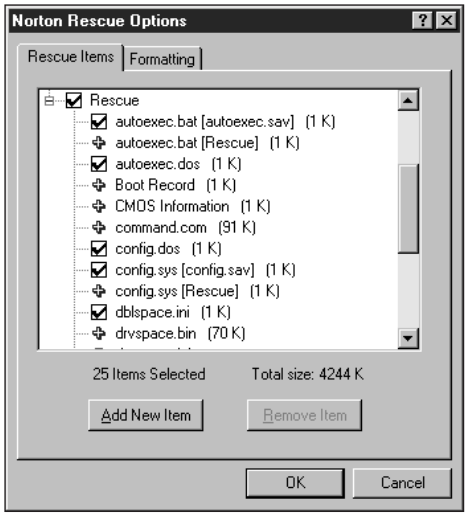

Figure 7-26 Files and information for the Norton rescue disk

One advantage of Partition Magic is that you can quickly and easily rearrange partitions to get the least amount of slack. If you are responsible for many PCs and often find yourself building hard drives, this software as well as other programs from PowerQuest can save you a lot of time. Other PowerQuest products to manage hard drives include:

- **DriveCopy** lets you copy an entire old hard drive to a new hard drive. This software can be a time saver if you need to build several hard drives that contain identical software. The drives don't have to be the same size for DriveCopy to work.
- **DriveImage** helps you manage a compressed, backup copy of your hard drive.
- **DriveImage Professional** does the same thing as DriveImage, in addition to allowing you to download the compressed backup of the hard drive to many PCs over a network.
- **Lost & Found** recovers data from a corrupted hard drive caused by either software or hardware problems.

SpinRite by Gibson Research

SpinRite by Gibson Research is hard drive utility software that has been around for years. When older hard drives could be low-level formatted, SpinRite was the tool most technicians turned to for the job. Today, SpinRite is still a DOS application without a sophisticated GUI interface, but it has been updated to adjust to new hard drive technology. It supports FAT32, SCSI, Zip drives, and Jaz drives. You can boot your PC from a floppy disk and run SpinRite from a floppy, which means that it doesn't require much system overhead. Because it is written in a low-level language (assembly language), it is more likely to detect underlying hard drive problems than software that uses Windows, that can stand as a masking layer between the software and the hard drive. SpinRite analyzes the entire hard drive surface, performing

data recovery of corrupted files and file system information. Sometimes, SpinRite can recover data from a failing hard drive when other software fails. For more information see Gibson Research at www.grc.com.

Problems with Hard Drives

A+CORE 2.1

Problems with hard drives can be caused by either hardware or software. Problems can also be categorized as those that prevent the hard drive from booting and those that prevent the data from being accessed. Hardware and software causes of hard drive problems can be summarized as follows:

1. Hardware Problems
   - Problems with the hard drive controller, power supply, data cable, BIOS, or setup—that is, with the supporting firmware and hardware needed to access the drive
   - Damage to the drive mechanism or physical damage to the disk surface where the partition table, boot record, directories, FAT, and/or the data itself are stored
2. Software Problems
   - Corrupted OS files
   - Corrupted partition table, boot record, or root directory, making all data on the hard drive inaccessible
   - Corruption of the area of the FAT that points to the data, the data's directory table, or the sector markings where the data is located
   - Corruption of the data itself
   - Data or access to it destroyed by a virus

Setting Priorities Before You Start

If a hard drive is not functioning and data is not accessible, setting priorities helps focus your work. For most users, the data is the first priority unless they have a recent backup. The software can also be a priority if it is not backed up. Reloading software from the original installation disks or CD-ROM can be time-consuming, especially if the configuration is complex or you have written software macros or scripts that are not backed up.

If you have good backups of both the data and software, the hardware might be your priority. It could be expensive to replace, and downtime can be costly. The point is, when trouble arises, determine your main priority and start by focusing on that.

Be aware of what resources are available to help you resolve a problem. Documentation lists error messages and their meanings. Technical support from the ROM BIOS, hardware, and software manufacturers can help you interpret an error message, or it can provide general support in diagnosing a problem. Most technical support is available during working hours by telephone. Check your documentation for telephone numbers.

An experienced computer troubleshooter once said, "The people who solve computer problems do it by trying something and making phone calls, trying something else and making more phone calls, and so on, until the problem is solved." There is a lot of truth in that statement.

The Internet can also help you diagnose hardware and software problems. Go to the Web site of the manufacturer of the product and search for an FAQ (frequently asked questions) list or bulletin board. It's likely that others have encountered the same problem and have posted the question and answer. If you search and can't find your answer, then you can post a new question.

Remember one last thing. After making a reasonable and diligent effort to resolve a problem, getting the problem fixed could become more important than resolving it yourself. There comes a time when you might need to turn the problem over to a more experienced technician.

Resolving Hard Drive Problems

Hardware problems usually show up at POST, unless there is physical damage to an area of the hard drive that is not accessed during POST. Hardware problems often make the hard drive totally inaccessible.

Sometimes older drives refuse to spin at POST. Drives that are having trouble spinning often whine at startup for several months before they finally refuse to spin altogether. If your drive whines loudly when you first turn on the computer, never turn the computer off. One of the worst things you can do for a drive that is having difficulty starting up is to leave the computer turned off for an extended period of time. Some drives, just like old cars, refuse to start if they are left unused for a long time.

Do not trust valuable data to a drive that is having this kind of trouble. Plan to replace the drive soon. In the meantime, make frequent backups and leave the power on.

Data on a hard drive sometimes "fades" off the hard drive over time. Also, the read/write heads at the ends of the read/write arms on a hard drive get extremely close to the platters but do not actually touch them. This minute clearance between the heads and platters makes hard drives susceptible to destruction. Should a computer be bumped or moved while the hard drive is in operation, a head can easily bump against the platter and scratch the surface. Such an accident causes a "hard drive crash," often making the hard drive unusable.

If the head mechanism is damaged, the drive and its data are probably a total loss. If the first tracks that contain the partition table, boot record, FAT, or root directory are damaged, the drive could be inaccessible although the data might be unharmed.

Here's a trick that might work for a hard drive whose head mechanism is intact but whose first few tracks are damaged. Find a working hard drive that has the same partition table information as the bad drive. With the computer case off, place the good drive on top of the bad drive housing, and connect a spare power cord and the data cable from the adapter to the good drive. Leave a power cord connected to the bad drive. Boot from a disk. No error message should show at POST. Access the good drive by entering C: at the A prompt. The C prompt should show on the monitor screen.

Without turning off the power, gently remove the data cable from the good drive and place it on the bad drive. Do not disturb the power cords on either drive or touch chips on the drive logic boards. Immediately copy the data you need from the bad drive to floppy disks, using the DOS COPY command. If the area of the drive where the data is stored, the FAT, and the directory are not damaged, this method should work. If the FAT is damaged, you might need to read sectors instead of files to retrieve the data, using either **DEBUG** (repeating the LOAD and WRITE commands for all sectors) or utility software.

Here's another trick for an older hard drive that is having trouble spinning when first turned on. Remove the drive from the case and, holding it firmly in both hands, give the drive a quick and sudden twist in such a way that the platters are forced to turn inside the drive housing. Reinstall the drive. It might take several tries to get the drive spinning. Once the drive is working, immediately make a backup and replace the drive soon.

For a hard drive to be accessible by DOS or Windows 9x, these items, listed in the order they are accessed, must be intact:

- The partition table
- The boot record
- The FAT
- The root directory

In addition to the preceding items, the following items must be intact for the hard drive to boot:

1. For DOS
   - The two DOS hidden files, IO.SYS and MSDOS.SYS (or IBMBIO.COM and IBMDOS.COM)
   - COMMAND.COM
   - CONFIG.SYS and AUTOEXEC.BAT (these are optional)
2. For Windows 9x
   - The two Windows 9x hidden files, IO.SYS and MSDOS.SYS
   - COMMAND.COM
   - CONFIG.SYS and AUTOEXEC.BAT (these are optional)
   - VMM32.VXD and several files that it uses to load the desktop

A+ OS 3.1

Windows 9x can be loaded to a command prompt, rather than a desktop. You can load just enough of the OS to attain a command prompt. If you press F8 as Windows loads, you can then choose the command prompt. Doing this gives you the C prompt provided by COMMAND.COM and prevents VMM32.VXD from loading.

The hard drive does not have to be bootable to access the data. You can always boot from a floppy disk and then access drive C. After Windows 9x or DOS accesses the drive, in order for the OS to access the data these items must be intact:

- The directory in which the files are located
- In the FAT, the sector information where the files are located

- The beginning of the file, sometimes called the header information, and the end of the file, called the end-of-file marker
- The data itself

Reviewing the preceding three lists, you can see that there are several opportunities for failure. To recover lost data due to a software problem, you must first determine which item is corrupted. Then you must either repair the item or bypass it to recover the data.

Preparing for Disaster As discussed earlier, Nuts & Bolts and Norton Utilities both offer a version of Image, a utility program that makes a copy of important hard drive information, including the boot record, FAT, and root directory. You can configure your PC to execute Image each time you boot. The software can also track when you have made the last image and prompt you to make another when the information becomes outdated.

Figure 7-13 showed the Properties dialog box for McAfee Image, where you can choose to create an image each time you start Windows. Using the Image file to recover from a hard drive disaster was covered earlier in the chapter.

Damaged Partition Table

A+ CORE 2.1

A+ OS 3.2

If the hard drive and its supporting hardware pass the POST tests done by startup BIOS, BIOS tries to load an OS from the hard drive if no floppy disk is in drive A. Even if the OS is loaded from a floppy disk, the partition table and the boot record must be intact for the OS to access the hard drive. The FAT and root directory must be readable for the OS to read data stored on the drive.

BIOS first reads the master boot program at the beginning of the partition table information on the hard drive. If the partition table is damaged, the error message is as follows:

```
Invalid drive or drive specification
```

In this case, you should still be able to boot from a floppy disk. When you get to the A prompt and try to access the hard drive by entering C:, you will get the same error.

If you suspect that the partition table is corrupted, use the FDISK command discussed earlier in the chapter to display the partition table information. The FDISK command will give an error when trying to display the information if the table is corrupted.

Restoring the partition table is impossible if the track is physically damaged. However, if you have previously saved the partition table and there is no physical damage, the process is simple. In Chapter 6, you learned that you can save the partition table to a disk using Norton Utilities, Nuts & Bolts, or the DOS 5 MIRROR command. If you have not saved this information, but you have another hard drive with a matching partition table, try saving the table from the good drive and writing it to the bad drive. Sometimes the UNFORMAT command will allow this.

If you have saved the information using the DOS MIRROR command, restore the partition table with this command:

```
UNFORMAT /PARTN
```

The command prompts you for the disk containing the file PARTNSAV.FIL, and it restores the partition table and boot records for all partitions on the drive.

Also, to recover the FAT, directories, and files, this variation of the UNFORMAT command sometimes gives results:

```
UNFORMAT /U
```

Nuts & Bolts Disk Minder, Norton Disk Doctor, and SpinRite also can repair a damaged partition table. You must have the utility software on floppy disks and execute the program from the disks. If you have made a set of rescue disks with Nuts & Bolts or Norton Utilities, use these disks to restore the partition table. If you have not made a set of rescue disks, try the Emergency Disks, which can sometimes correct the problem. If SpinRite instructs you to make a bootable disk on another PC, install SpinRite on the disk, and then use the disk to repair the hard drive.

A+ OS 3.2

Don't use FDISK to make a new partition table, because it will also overwrite the first few sectors on the hard drive that contain the FAT. Part of the partition information can be recovered using FDISK with the /MBR parameter. When the following error message is displayed, first boot from a floppy disk.

```
Invalid Drive or Drive Specification
```

Then to restore the boot program in the partition table (called the master boot record), which is at the very beginning of the partition table information, try this command:

```
A> FDISK /MBR
```

Oftentimes, this command solves the problem. Note that the /MBR option is not documented in the DOS or Windows 9x manuals. The FDISK program must be stored on the floppy disk in drive A; keep a copy of it on an emergency bootable disk for just this purpose.

You can, however, start over by repartitioning and reformatting the drive. Although the first few tracks are damaged, you might still be able to recover part of the storage space on the drive. The partition table is written on the very first sector of the hard drive, and this sector must be accessible. After that, you can skip as many sectors as you need to by making a non-DOS or non-Windows 9x partition at the beginning of the drive. This partition will never be used. Make the second partition, which will be the first DOS or Windows 9x partition, the bootable partition. All this is done using the FDISK command available in either DOS or Windows 9x, or you can use Partition Magic.

Don't perform a low-level format on an IDE or SCSI drive unless the drive is otherwise unusable. Use the low-level format program recommended by the manufacturer, and follow its instructions. Call the drive manufacturer's technical support to find out how to get this program, or check the manufacturer's Web site for details.

Damaged Boot Record

A+ OS 3.1

If the boot record on a hard drive is damaged, you cannot boot from the hard drive. After you boot from a floppy disk and try to access the hard drive, you might get an error message such as "Invalid media type", "Non-DOS disk", or "Unable to read from Drive C."

If the boot record is damaged, the best solution is to recover it from the backup copy you made when you first became responsible for the PC. If you did not make the backup, try SpinRite, Norton Utilities Disk Doctor, or Nuts & Bolts Disk Minder. Figure 7-27 shows Help information from Norton Utilities about testing the boot record. Recall that a floppy disk has only one boot record, but a hard drive has one master boot record in the partition table area and a boot record at the beginning of each logical drive or volume on the drive.

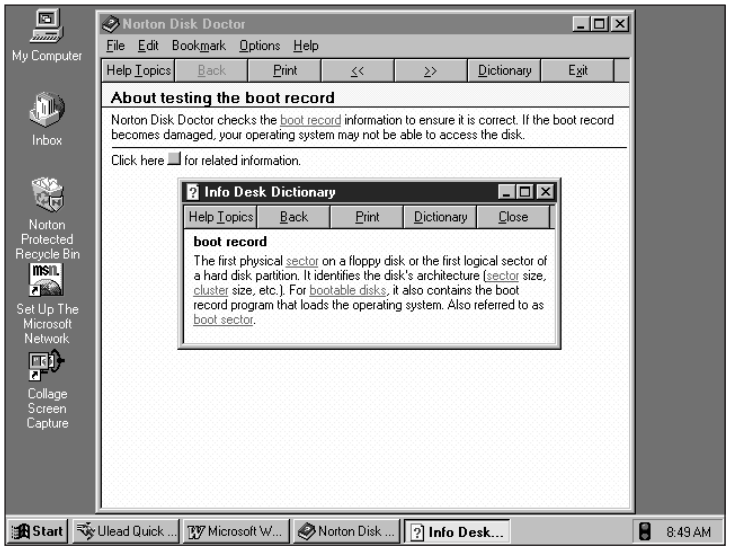

Figure 7-27 Help from Norton Utilities about testing the boot record

Norton Disk Doctor tests and repairs the damaged boot record if it can. The Norton Utilities Rescue Disk simply refreshes the boot record with the backup copy on the disk. To use Norton Disk Doctor, click **Start**, **Programs**, **Norton**, and **Norton Disk Doctor**. Select the hard drive from the list of drives displayed on the first screen of the program and click **Diagnose**. The dialog box in Figure 7-28 is displayed as Norton Disk Doctor tests the entire drive, including the boot record. If it discovers errors in the boot record or other areas of the disk, it asks permission to repair the damage or repairs it without asking permission, depending on how you have set the program options. Figure 7-29 displays the test results. When you click **Details** you can print a detailed report of the test and any corrections made.

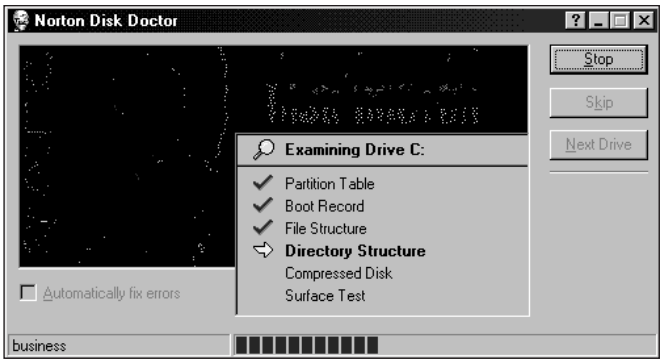

Figure 7-28 Norton Disk Doctor examining a hard drive

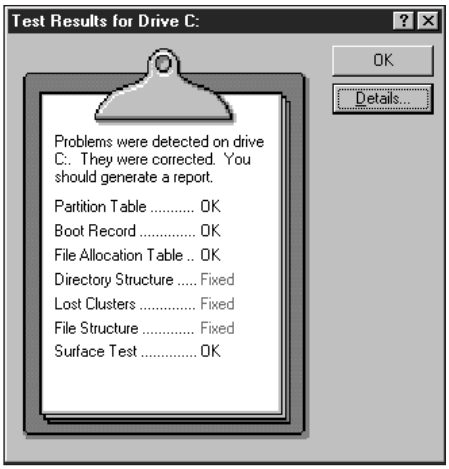

Figure 7-29 Norton Disk Doctor displays test results for drive C

Damaged FAT or Root Directory

A+ OS 3.1, 3.2

The partition table and boot record are easily backed up to disk; they will not change unless the drive is repartitioned or reformatted. Always back them up as soon as you can after you buy a new computer or become responsible for a working one.

Unlike the partition table and boot record, the FAT and the root directory change often and are more difficult to back up. SpinRite, Nuts & Bolts Disk Minder, and Norton Disk Doctor provide tools to repair a damaged FAT or root directory. Their degree of success is dependent on the degree of damage to the tables.

One message generated by a hard drive with a damaged file allocation table is:

```
Sector not found reading drive C, Abort, Retry, Ignore,
Fail?
```

Sometimes, however, you do not see an error message; files or directories are simply missing. Nuts & Bolts and Norton Utilities can be used to recover from a corrupted FAT.

If the physical areas of the FAT and root directory are damaged and you cannot repair them, you can still read data from the hard drive by reading sectors instead of files. With Norton Disk Editor, read one sector at a time and write each to a disk or use Lost and Found.

Norton Utilities The two Norton Utilities programs that might be helpful in repairing a damaged FAT and other areas of the hard drive are Norton Disk Doctor and Disk Editor. Norton Disk Doctor does not require you to understand what the program is examining or doing to the drive. Disk Editor gives you more control, but this also means you must understand what you are doing as you make decisions and edit critical areas of the hard drive yourself.

Norton Disk Doctor Norton Disk Doctor, discussed earlier in the chapter, offers an automated way to examine a disk or hard drive and to reconstruct it where the programs deem necessary. Norton Disk Doctor might be able to reconstruct a boot record, a copy of the FAT, a directory, and even files. In some situations it is an easy fix for a damaged disk.

Norton Disk Editor Norton Disk Editor can automatically repair a damaged floppy disk or hard drive, including damage to the FAT, or you can make changes directly to a copy of the FAT and to the directory. As you move the cursor over the FAT entries, all the entries for one file change color so that they are easy to find and edit.

For example, Disk Editor allows you to take a damaged hard drive or floppy disk that has a fragmented file that you want to recover, and copy the file, sector by sector, to a floppy disk. Disk Editor creates a new file on the floppy disk and appends one sector from the damaged drive after another to that new file.

The time to learn how to use Disk Editor is not when you need it but before you need it. Learn how to use Disk Editor by practicing on floppy disks. Start with a floppy disk that has several files, and examine the root directory, the FAT, and the files themselves. Practice data recovery by copying a file one sector at a time to a new disk. The activities at the end of the chapter will help you gain experience by working with disks.

For a truly damaged floppy disk with important data on it, be sure to make a copy of the disk before you start working with it. Try Windows 9x Copy Disk or DOS DISKCOPY first. If they will not copy your disk, try Norton's UNDO feature before you begin editing the disk.

Nuts & Bolts Use Disk Minder to recover a corrupted FAT on either a floppy disk or hard drive. The process is automatic but does give you the option to choose what to repair and what to leave as is. Under the Disk Minder Properties box, shown in Figure 7-30, remove the check from **Auto Fix Errors**. When Disk Minder finds errors on the hard drive, including errors in the FAT, it prompts you before making changes.

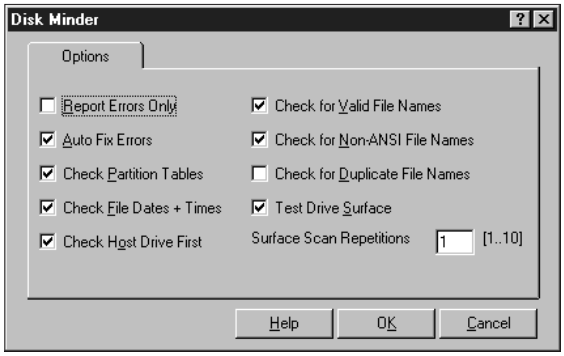

Figure 7-30 Nuts & Bolts Disk Minder will check these things on a disk

Using Norton Disk Editor to View a FAT Viewing a FAT with Norton Disk Editor gives you a clear picture of how a data file is written to a disk. The FAT can also be used to recover a **corrupted file**, because you can locate each cluster of the file and copy the data, cluster by cluster, to a new disk.

One way to access Disk Editor is to click **Start**, **Programs**, **Norton**, **Disk Editor**. Windows 9x unloads, and Disk Editor loads from DOS. Another way to load Disk Editor is to type DISKEDIT at the command prompt. Norton Utilities puts a copy of DISKEDIT.EXE on the rescue disks, and it's also located on the Emergency Disks that come as a part of the software.

From the opening menu, select the **Object** menu (**Alt+O**) and select **A: 3½ Floppy** as the object. Click **OK**.

Select the **Object** menu again; this time select **1ST FAT** from the Object menu. The FAT is displayed as a table of entries, each entry representing one cluster on the disk, as shown in Figure 7-31. Look at the bottom of the screen for the current cluster in the FAT. The entry in that cluster location will either be <EOF> to mark the end of the file or the pointer to the next cluster in the file.

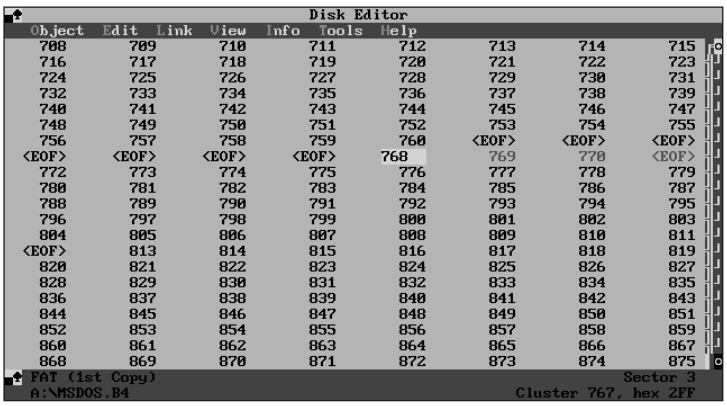

Figure 7-31 Norton Utilities Disk Editor in FAT view

Corrupted System Files

A+ OS 3.2, 3.1, 1.2

If the two OS hidden files are missing or corrupted, you should see the following error message for DOS:

```
Non-system disk or disk error...
```

or for Windows 9x:

```
Invalid system disk...
```

When this happens, first boot from a floppy disk, then access drive C, and begin looking for the problem. Use the ATTRIB command to unhide all files in the root directory, as follows:

```
C:\> ATTRIB -H *.*
```

You should see the two exposed hidden files if they are there. If they are missing or corrupted, you can use the COPY command to copy them from a disk to the hard drive root directory. (Unhide them on the disk first, so COPY can find them.) Once they are on the hard drive, hide them again with these commands:

```
C:\> ATTRIB +H IO.SYS
C:\> ATTRIB +H MSDOS.SYS
```

Substitute another filename as necessary. You can also use this command:

```
A:\> SYS C:
```

The SYS command copies the two hidden files and COMMAND.COM from the disk to the hard drive.

A+ OS 3.1

COMMAND.COM must be in the root directory. If COMMAND.COM is missing, you should get the following error message:

```
Command file not found
```

or something similar. You will probably find a spare copy in the \DOS directory or \Windows\command, or you can copy it from your bootable disk.

CONFIG.SYS and AUTOEXEC.BAT sometimes give errors when they are changed or accidentally erased. Keep a backup of these files so that you will not have to remember all the commands listed in them if you have to rebuild.

To prevent a user from accidentally erasing COMMAND.COM, CONFIG.SYS, and AUTOEXEC.BAT, you might want to hide these files, using the ATTRIB command in DOS or the Properties sheet in Windows 9x. You also can make them read-only files, using this version of ATTRIB for each file. For example, in COMMAND.COM you can use:

```
ATTRIB +R COMMAND.COM
```

Corrupted Sector and Track Markings

The first few bits of each sector are labels that the hard drive BIOS must read before it reads any data in that sector. The data might be perfectly fine, but, if the sector markings are faded, BIOS will not read the sector. DOS will give you the following error message:

```
Bad Sector or Sector Not Found
```

SpinRite, Nuts & Bolts, Norton Utilities, or Lost and Found might be able to read the sector. Try them first. If one can read the data, copy the data to a disk and have the utility mark the cluster as bad in the FAT so that it will not be used again. If the drive continues to report bad sectors, it needs to be low-level formatted. Only the low-level format will refresh these sector bits.

There are two kinds of **low-level formats**: a nondestructive and a destructive format. The nondestructive format does not destroy the data. It copies the data on one track to another area of the drive, rewrites the sector bits on that track, and then copies the data back to the track.

A destructive low-level format completely ignores old format information and starts all over again, writing track and sector markings to the drive and overwriting all data. The advantages of using a destructive format are that it's faster and does a better job of determining bad sectors and marking them than a nondestructive format. If you have a choice, choose the destructive format.

Remember that it is dangerous to low-level format an IDE drive because the track and sector locations can be specific to this drive. Only use a low-level format program recommended by the drive manufacturer.

Corrupted Data and Program Files

Data and program files can become corrupted for many reasons, ranging from power spikes to user error. If the corrupted file is a program file, the simplest solution might be to reinstall the software or recover the file from a previous backup.

To restore a data file that is not backed up, you have three options:

- Use operating system tools and commands to recover the file.
- Use Nuts & Bolts, Norton Utilities, Lost and Found, SpinRite, or other third-party software to recover the file.
- If neither of these approaches works, you can turn to a professional data recovery service. These services can be expensive, but, depending on how valuable the data is, the cost might be justified.

Using OS Tools and Commands to Recover Data

When a data file or program file is damaged, portions of the file may still be intact. The basic approach to recovering data in this situation is to create a new file on another disk or on the

hard drive, containing all the sectors from the original file that can be read from the damaged disk or hard drive. Then edit the newly created file to replace the missing data.

How successfully an OS recovers data depends on how badly damaged the file is. A few examples of how data commonly becomes damaged and what can be done to recover it are discussed below. If a file has been accidentally erased, or the disk or hard drive is otherwise damaged, remember these two things: (1) don't write anything to the disk or hard drive, because you may overwrite data that you might otherwise recover, and (2) if you are recovering data from a disk, use DISKCOPY in DOS or, for Windows 9x, use Copy Disk in Explorer to make a copy of the disk before you do anything else. If Copy Disk or DISKCOPY doesn't work, try copying the disk with Norton Utilities or Nuts & Bolts.

Corrupted File Header If an application cannot open or read one of its data files, the file header might be corrupted. Many applications place header information (called the file header) at the beginning of the file. This data follows a different format from the rest of the file. The application uses it to identify the file and its contents. If the file header is lost or corrupted and an application needs that header to read the file, you can sometimes recover the contents by treating the file as an ASCII text file. Most applications let you import a text file, and then convert it to the application's format. Read your application's documentation to learn how to import a text file.

Lost Allocation Units A disk can develop **lost allocation units** or lost clusters if a program cannot properly close a file it has opened. For example, if you boot your computer while an application is running (not a good thing to do for this very reason), the application will not have the oppertunity to close a file and may lose clusters. Another way clusters can be lost is if you remove a floppy disk from a drive while the drive light is still on (also not a good thing to do).

A+ OS 3.2

Lost clusters make up a chain of clusters that are not incorporated into a file. The CHKDSK and SCANDISK commands take this chain of clusters, turn it into a file with the name FILE0000.CHK or a similar filename with a higher number, and store the file in the root directory. To use this utility in DOS to access lost clusters, use the command with the /F option, like this:

```
C:\> CHKDSK A:/F
```

Often the file created can be used by the application that it belongs to, although you might have to change the file extension so the application will recognize the file.

For Windows 9x, use the ScanDisk utility described in Chapter 6 to accomplish the same results.

Bad Sectors Error messages that occur when a file is read might be caused by bad sectors on the floppy disk or hard drive. If a disk contains bad sectors, the COPY command can sometimes recover the remaining file data located in the good sectors. For example, if you have a disk in drive A that has bad sectors, and a file named DOCUMENT.DOC is unreadable by an application, for DOS try this command:

```
C:\TEMP> COPY A:DOCUMENT.DOC
```

Choose the **Ignore** option by pressing I when the following message appears:

```
Unable to read from Drive A: Abort, Retry, Ignore
```

DOS ignores that bad sector and moves on to the next sector. You should be able to copy at least part of the file on the disk.

For Windows, use the COPY command from File Manager in Windows 3.x or Explorer in Windows 9x.

Try the RECOVER command on only one file at a time. Don't use it at all unless you have made a backup copy of the disk or you have no other option. Sometimes the RECOVER command actually destroys data that might have been recovered by some other method. As with CHKDSK, you might have to rename the file created by RECOVER so that its application recognizes it.

Erased File With DOS, if a file has been erased by the DOS DEL or ERASE command, it can sometimes be recovered. DOS offers the UNERASE or UNDELETE command that recovers some erased files. When DOS deletes a file from a disk or hard drive, it does so as follows:

- The first character of the filename in the root directory is overwritten with the character s, which has the hex value E5
- All entries in the FAT for this file are replaced with 00s

When you issue the DOS UNDELETE command, DOS looks for an entry in the root directory matching the filename and replaces the first character of the filename in the root directory. From the root directory, DOS can read the starting cluster of the file and the size of the file. If the file is not too fragmented and the disk is otherwise healthy, DOS can locate the sectors belonging to the file and reconstruct the FAT.

When you delete a file using Windows 9x, this OS handles floppy disk files differently from hard drive files. Windows 9x floppy disk files are treated the same way DOS treats any file that has been deleted; in other words, there's no Recycle Bin. (The Windows Recycle Bin is a special folder on the hard drive where Windows lists files that have been erased so that they can be unerased if necessary.) Windows 9x offers no tools to undelete a file from a floppy disk. However, for a hard drive, the file is moved to the Recycle Bin and stays there until you purge it. The file information is still retained in the FAT, and the file takes up space on the hard drive. You can recover the file simply by dragging it from the Recycle Bin to a new location. If the file has been deleted from the Recycle Bin, you might still be able to recover the file by using the DOS UNDELETE command. This command is not included with Windows 9x, so you must look for it in your older DOS 5.x or DOS 6.x directory. To undelete a file from Windows 9x using DOS UNDELETE, follow this procedure:

1. From the Windows 9x Start menu, choose **Shut Down**, and then choose **Restart the computer in MS-DOS mode**.
2. At the DOS prompt, type **LOCK**, which makes the FAT and directories available for DOS utilities without allowing other applications to access them.

3. Undelete the file using the DOS UNDELETE command. Don't forget to include the path in the command line as necessary.
4. Type **UNLOCK** to release the file system to applications.
5. Type **EXIT** to relaunch Windows 9x.

Using Utility Software to Recover Files

Norton Utilities and Lost and Found offer user-friendly ways to recover files. Norton Disk Doctor can often do the work (and the thinking) for you. You have more control, however, with Norton Disk Editor.

Norton Utilities There are two approaches to using Norton Disk Editor to recover a file. One is to copy the file, sector by sector, to another disk or hard drive. You can locate the file by looking in the root directory for the starting cluster number and the size of the file. From the file size and the size of one cluster, calculate the number of clusters the file uses. Next, go to the FAT and look for the entries beginning with the first cluster in the file. The Disk Editor in FAT view is shown in Figure 7-31. If the FAT has been erased (for example, when the file was accidentally deleted), the FAT is virtually useless. However, clusters currently in use in the FAT can be eliminated as possible locations for the file, unless, of course, the file was overwritten after the deletion occurred. Write down or print all the information that you can get from the FAT.

Next go to the disk data area and read the disk as single sectors. Use the list from the FAT to locate the data. You need to know what you're looking for. Try to get the latest printout of the file if one exists. If there is no printout, you at least need to know what the data looks like so that you can recognize it. With Disk Editor, create a file on another disk and copy one sector after another to the new file, appending each sector to the file.

The second approach to using Disk Editor is to edit the root directory and FAT entries on the damaged disk to point to that area on the disk that is undamaged. Suppose, for example, you discover that only a few clusters of a 128-cluster file are damaged. The file begins at cluster 150. You can read the file, cluster by cluster, using Disk Editor, until you get to cluster 221. Good data picks up again at cluster 229. Here's what you do:

1. Edit the root directory of the original file, changing the size of the file to the number of bytes of the original file less the number of bytes in the damaged clusters. You need to know the number of bytes in one cluster for this disk.
2. Change the FAT entry at 220 to point to 229, not 221. Do the same for the second copy of the FAT.
3. Having altered the directory and FATs so that they do not read the damaged sectors, immediately copy the file to a new disk.

You can actually create files on a disk using the above method. By using a disk editor or DEBUG (a disk editor is much easier), you can add a new entry to the root directory and edit the two FATs to point to all the sectors on the disk you need for the file. The new file

now exists! This method works well if you have a damaged data area of the disk but the root directory and FATs are still somewhat intact.

Lost & Found Lost & Found by PowerQuest can recover data quickly and easily. This relatively new software does not attempt to fix disk problems; in fact, it does not write to the problem disk at all, but only reads and copies the data to another disk. PowerQuest offers a free demo that you can download from their Web site. Use the demo to determine if Lost & Found can recover your data before you have to purchase it. For more information, see *www.powerquest.com*.

SpinRite SpinRite by Gibson Research can recover files on hard drives, floppy disks, and removable drives. You can run the program from within Windows, but, for best results, boot from a floppy and run the program from the floppy. For more information, see *www.grc.com*.

Virus Problems

If you suspect that a virus could be your problem, use a virus scan program to scan memory and your hard drive for an active or inactive virus.

Hard Drive Troubleshooting Guidelines

This section summarizes the steps to follow when troubleshooting a hard drive problem, listing several problems, their causes, and possible solutions. These and other troubleshooting guidelines are collectively listed in Appendix E as a quick reference while on the job to help give you ideas as to how to proceed when problem solving.

Begin troubleshooting by interviewing the user, being sure to include the following questions:

1. Was the computer recently moved?
2. Was any new hardware recently installed?
3. Was any new software recently installed?
4. Was any software recently reconfigured or upgraded?
5. Does the computer have a history of similar problems?

As you have learned in this chapter, hard drives can malfunction in many ways, including the ones discussed below.

Hard Drive Does Not Boot

A+ OS 3.1, 3.2

If the hard drive does not boot, proceed as follows:

- Confirm that both the monitor and computer switches are turned on.
- Sometimes startup BIOS displays numeric error codes during POST. Errors in the 1700s or 10400s generally mean fixed disk problems. Check the Web site of the BIOS manufacturer for explanations of these numeric codes.

A+ OS 3.1, 3.2

- For SCSI drives, numeric error codes 096xxxx, 112xxxx, 113xxxx, 206xxxx, 208xxxx, 210xxxx, or 1999xxxx generally mean problems with the host adapter.
- For SCSI drives, reseat the host adapter card and check terminators.
- Disconnect and clean the edge connectors on the adapter card, if present.
- Check CMOS setup for errors in the hard drive configuration.
- Try using a bootable disk, then log on to drive C. If you have a Windows 9x rescue disk, you can use SCANDISK, CHKDSK, or FDISK to examine the system.
- If the PC does not boot from the boot disk, verify that the boot disk is good. Try using it in a different computer. To protect against viruses, write protect the boot disk first.
- Check to be sure the power cable and disk controller cable connections are good.
- If the drive still does not boot, exchange the three field-replaceable units for a hard drive subsystem (the data cable, the adapter card, and the hard drive itself). Perform the following procedures in order.
- Reconnect or swap the drive data cable.
- Reseat or exchange the drive adapter card, if one is present.
- Exchange the hard drive for one you know is good (in computer jargon, this is called a known-good unit).
- If the hard drive refuses to work, but the hard drive light stays on even after the system has fully rebooted, the problem might be a faulty controller on the hard drive or system board. Try replacing the hard drive, then the system board.

A bad power supply or a bad system board also might cause a disk boot failure. If the problem is solved by exchanging one of the above field-replaceable units, you still must reinstall the old unit to verify that the problem was not caused by a bad connection.

Damaged, missing, or mismatched system files (COMMAND.COM, IO.SYS, MSDOS.SYS) can keep a hard disk from booting. You can see if they are of the same version by typing DIR/AH. This will show the hidden system files and their dates. If COMMAND.COM and the hidden files have different dates, then they are usually mixed and incompatible versions. You can replace the three system files using the following steps:

- Boot a rescue or system DOS disk from drive A (make sure you are using the same DOS version).
- Restore hidden system files on drive C (A:\>SYS C:).
- Older versions of DOS require you to copy COMMAND.COM separately. You can restore COMMAND.COM by typing:

```
A:\>COPY COMMAND.COM C:
```

- Run SCANDISK.
- Run a current version of an antivirus program.

Drive Retrieves and Saves Data Slowly

A+ OS 3.2

If the drive retrieves and saves data slowly, proceed as follows:

- Run DEFRAG to rewrite fragmented files to contiguous sectors. Slow data retrieval might be caused by fragmented files that have been updated, modified, and spread over different portions of the disk.
- Verify that the hard disk drivers are properly installed.

Computer Will Not Recognize a Newly Installed Hard Drive

If the computer will not recognize a newly installed hard drive, proceed as follows:

- Does the manual state that you must first do a "low-level" format or run a Disk Manager? IDE drives are already low-level formatted. Older drives require the user to perform this routine.
- Has the FDISK utility been successfully run? Choose "Display Partition Information" from the FDISK menu to verify the status.
- FORMAT C:/S is the last required "format" step. Has this been done?
- Has the CMOS setup been correctly configured?
- Are there any drivers to install?
- Are there any DIP switches or jumpers that must be set?
- Has the data cable been properly connected? Verify that the cable stripes are connected to pin 1 on the edge connectors of both the card and cable.
- Check the web site of the drive manufacturer for suggestions if the above steps are not productive.

Chapter Summary

- Installing a hard drive includes setting jumpers or DIP switches on the drive; physically installing the adapter card, cable, and drive; changing CMOS setup; and partitioning, formatting, and installing software on the drive.
- An IDE hard drive can be installed as a master drive, slave drive, or single drive on a system.
- Protect the drive and the PC against static electricity during installation.
- The EIDE standards support two IDE connections, a primary and a secondary. Each connection can support up to two IDE devices for a total of four devices on a system.
- IDE devices under the EIDE standard can be hard drives, CD-ROM drives, tape drives, Zip drives, and others.

- Large-capacity hard drives must have either LBA mode or large mode set in CMOS in order for system BIOS to support the drive. Without this support, device driver software or a special EIDE adapter card specific to the drive must be used.
- Most BIOSs today can autodetect the presence of a hard drive if the drive is designed to give this information to BIOS.
- A drive must have one primary partition and can have one extended partition. The drive boots from the primary partition. The extended partition can be subdivided into several logical drive partitions.
- Use more than one partition to optimize the cluster size, to handle drives greater than 2 GB when using FAT16, or to improve the organization of the software on the drive.
- With FAT32, the hard drive can be partitioned using a single partition with a single logical drive.
- The OS, or high-level, format creates the FATs, root directory, and boot record on the drive and marks any bad clusters in the FAT that the low-level format had previously identified.
- A Windows 95 upgrade requires that DOS and Windows 3.x are previously installed on the drive or the Windows 3.x setup disk is available.
- You can make a backup of the partition table with the MIRROR command, Nuts & Bolts, Norton Utilities, or Partition Magic.
- Installing a SCSI drive involves installing the host adapter, terminating resistors, setting SCSI IDs, and configuring the SCSI system to consider whether the drive is the boot device or not.
- Windows 9x and DOS with Windows 3.x can be installed on the same hard drive, and you can boot to either OS.
- High humidity, smoking near the PC, and leaving the PC turned off for long periods can damage a hard drive.
- Utility software, such as Lost & Found and Norton Utilities, can sometimes be used to quickly recover lost hard drive information and data without extensive knowledge or an understanding of the problem.
- Sometimes the second copy of the FAT on a hard drive can be used when the first copy becomes corrupted.
- ScanDisk and CHKDSK can be used to recover lost allocation units caused by files not being properly closed by the application creating them.
- When data is lost on a hard drive, don't write anything to the drive if you intend to try to recover the data.
- Low-level formats should be used as a last resort to restore an unreliable IDE hard drive. Only use the low-level format program recommended by the drive manufacturer.

Key Terms

Auto detection — A feature on newer system BIOS and hard drives that automatically identifies and configures a new drive in the CMOS setup.

Boot record (of hard drives) — The first sector of each logical drive in a partition that contains information about the logical drive. If the boot record is in the active partition, then it is used to boot the OS. Also called DOS boot record or OS boot record.

Corrupted files — Data and program files that are damaged for any of a variety of reasons, ranging from power spikes to user error.

DEBUG utility — A DOS utility that shows exactly what is written to a file or memory, using the hexadecimal numbering system to display memory addresses and data.

Disk Editor by Norton — A powerful tool for editing any part of a disk, including the partition table, directory entries, DOS boot record, and FAT.

High-level format — Formatting performed by means of the DOS or Windows 9x Format program (for example, FORMAT C:/S creates the boot record, FAT, and root directory on drive C and makes the drive bootable). Also called OS format.

Interleave — To write data in nonconsecutive sectors around a track, so that time is not wasted waiting for the disk to make a full revolution before the next sector is read.

Lost allocation units — *See* Lost clusters.

Lost clusters — File fragments that, according to the file allocation table, contain data that does not belong to any file (in DOS, the command CHKDSK /F can free these fragments). Also called lost allocation units.

Low-level format — A process (usually performed at the factory) that electronically creates the hard drive tracks and sectors and tests for bad spots on the disk surface.

Operating system format — *See* High-level format.

Partition table — A table written at the very beginning of a hard drive, which describes the number and location of all partitions, and identifies the boot partition.

SCSI bus — A bus standard used for peripheral devices tied together in a daisy chain.

Utility software — Software packages, such as Nuts & Bolts or Norton Utilities, that provide the means for data recovery and repair, virus detection, and the creation of backups.

Review Questions

1. When two hard drives are connected to the same data cable, how does BIOS know which is the master and which is the slave drive?
2. If a system board has two EIDE connections, how many IDE devices can the system support?
3. If a hard drive is too small to physically fit snugly into the drive bay, what can you do?
4. What is the purpose of the hard drive light on the front of a computer case?
5. How can you tell which side of a hard drive's data cable connects to pin 1 on the drive?

6. What are large-capacity drives? What are two methods that BIOS can use to support them?
7. What are the two limitations in standards that caused older BIOSs to not support drives larger than 528 MB?
8. If your BIOS does not support a large-capacity drive that you want to install, what four choices do you have?
9. How can you tell if your system board chip set supports Ultra DMA mode?
10. What OS utility is used to partition a hard drive?
11. How can you tell how many partitions a hard drive has been set up to have?
12. For a hard drive, describe the difference between a master boot record and a OS boot record.
13. Where on a hard drive is the information about the number and sizes of partitions stored?
14. What is the minimum number of partitions you can use for a 3-GB hard drive in a Windows 98 environment using FAT16? Why?
15. In Question 13 above, if you want to use only a single partition for the entire drive, what can you do?
16. When running FDISK under Windows 98, if you answer positively to the question, "Enable large disk support?" what does FDISK then do?
17. What is the cluster size for a 1.5-GB partition using FAT16? Using FAT32?
18. When would you be required to use FAT16 instead of FAT32 to partition a drive?
19. If a hard drive is using FAT16, what value is put in the FAT entry to indicate that the cluster is bad?
20. What is the difference between a bad cluster and a lost cluster?
21. What could cause a lost cluster?
22. What condition might prevent a deleted file from being undeleted?
23. Before you call the manufacturer's technical support for a hard drive during installation, what should you have in hand?
24. When you are installing a SCSI drive and an IDE drive on the same system, under what circumstances can the SCSI drive be the boot device?
25. In a dual boot situation between Windows 98 and DOS 6, when Windows 98 boots, what does it do with the DOS 6 system files?
26. Name two third-party utility software applications that can be used to manage and maintain hard drives.
27. What is one way that you can make a backup of partition information on a hard drive?
28. How can you tell if your hard drive is using normal, LBA, or large mode?
29. How can you unerase a file in Windows 98?
30. List three components to check or examine if a hard drive does not boot.
31. What is the one most important thing you can do to protect your data on a hard drive?

PROJECTS

Preparing for Hard Drive Hardware Problems

1. Boot your PC and make certain that it is working properly. Make sure you have a bootable disk available in case you need it. Turn off your computer, remove the computer case, and loosen the adapter card to your hard drive. Turn the computer back on. Write down the message that you get.
2. Turn the computer off and reseat the card. Disconnect the data cable and turn the computer back on. Write down the error that you get.
3. Turn off the computer and reconnect the data cable. Disconnect the power supply cord to the hard drive. Turn the computer on. Write down the error that you get.
4. Turn off the computer, reconnect the power cord, and turn on the computer. Rename COMMAND.COM in the root directory of your hard drive and reboot. Write down the error that you get. Reboot from the bootable floppy and rename the file on the hard drive back to COMMAND.COM. Reboot again to make certain that all is well.
5. Access Setup, write down the hard drive type and parameters you have, change the type, and reboot. Write down the errors you get. Access Setup, restore the drive type to the correct value, and reboot.
6. For DOS, add the following files to the rescue disk that you created in the Chapter 2 "Projects."
   - FDISK.EXE (to display partition information and to refurbish the master boot record with the command FDISK/MBR)
   - FORMAT.COM
   - SYS.COM
   - A copy of the partition table of your hard drive (use the DOS MIRROR command or some other utility software)
   - DEBUG.EXE (to examine the hard drive)
   - EDIT.COM (to create a new AUTOEXEC.BAT and other files)
   - QBASIC.EXE (a program that EDIT.COM needs to work if you have an older version of DOS)
   - Your current AUTOEXEC.BAT and CONFIG.SYS files if you have them on the hard drive
7. For Windows 9x, get a listing of all the files that Windows 9x puts on a rescue disk that it creates. Explain as far as you can the purpose of each file.

Data Recovery

The following exercises are designed to help you practice working with the tools used to recover data from floppy disks and hard drives.

1. The volume label is stored in two places on a floppy disk: the boot record and the root directory. Use a floppy disk that does not contain important information. To practice editing skills and test your knowledge of a floppy disk layout, change the volume label of a floppy disk, using either DEBUG or Norton Utilities disk editors.
2. Work with a partner on this problem. Separately alter an entry in the FAT of a file on a floppy disk, using Nuts & Bolts, DEBUG, or Norton Utilities. Don't tell your partner which file is damaged or what you did to the FAT. Exchange disks. Use DEBUG, Norton Utilities, SpinRite, Nuts & Bolts, or Lost & Found to repair the damaged FAT. Don't practice this exercise on a hard drive!
3. Use a healthy floppy disk that has at least one file stored on it. Edit the directory entry and the two FATs and divide the file into two files. Both files should be readable. Document or text files are better here than database or spreadsheet files that have header information.
4. Use a healthy floppy disk that is full of unimportant document or text files. Take a straight pin and make a small hole in the disk. Recover as much of the data on the disk as you can. When you're finished with this exercise, throw the disk away!
5. If a floppy disk has a damaged cover, it is still possible to recover the data on the disk. Cut the cover so you can remove the disk without damaging it. Sacrifice a good disk by cutting a slit carefully in the end of the cover, remove that disk, and insert the disk that had the damaged cover. Recover as much of the data on the disk as you can.

The Partition Table

Using Nuts & Bolts, Norton Utilities, or some other disk management software, get a printout of the partition table of your hard drive. On the printout, label each item in the table and explain it.

Research Using the Internet

Pretend you plan to install a Quantum Fireball CR 4.3-GB hard drive as a second drive on a PC. You want the drive to be the slave drive and know that you must change the current jumper settings. There are four jumpers on the drive, labeled DS, CS, PK, and Rsvd. From the description of the jumpers, you don't know how to set the jumpers so the drive is the slave. The documentation is not available. What do you do?

The best solution is to use the Internet to access the drive manufacturer's Web site for this information. In this case, the site is *www.quantum.com*. Use this example or some other example given by your instructor to determine the correct settings for the jumpers.

Recovering Data from a Floppy Disk

Use a floppy disk that contains data, but not important data that you cannot afford to lose. If you have Norton Utilities, use Disk Editor to alter the contents of the boot record on the disk so that the disk cannot be read by your OS. Recover the data on the disk.

Using Windows 9x Help

Using the Windows 9x **Start** button, **Help**, **Contents** tab, and **Troubleshooting** option, list specifically what to do if:

1. You run out of memory
2. You have trouble starting Windows

Troubleshooting a Hard Drive Problem over the Phone

A friend calls you to say that her hard drive does not work. She is using Windows 95 and has a rescue disk. Over the phone, walk her through the process of booting from the rescue disk and using the utilities on the rescue disk to examine the hard drive. List the utilities on the rescue disk that she should use in the order that she should use them, and write down for each utility what she should do with it.

In a lab environment, you can simulate this phone call by sitting with your back to a user sitting at a PC. Talk the user through the process without turning around and looking at the PC screen.

Hard Drive Troubleshooting

You have a virus scan program installed on your PC that executes each time you boot. The message it gives when it executes is "Unable to read boot record on drive C:". Is this the master boot record or the DOS boot record? What can you do to restore this information on the drive?

Using Nuts & Bolts

Using Nuts & Bolts utility software, make a snapshot image of the critical hard drive areas, using Image. Create a Nuts & Bolts rescue disk. Boot from the rescue disk. Use the DOS version of Disk Minder on the rescue disk to check the partition table for errors. Display the summary information from Disk Minder. Print the summary information screen.

From a DOS command prompt, delete a file on your hard drive that is expendable. Use Nuts & Bolts to recover the deleted file.

Using Nuts & Bolts Disk Tune, list the contents of clusters 20 through 29 on your hard drive.

Preparing for Disaster

Using Windows 9x Explorer, format a bootable system disk in drive A, and copy the following files from C:\Windows\Command to the new disk:

ATTRIB, CHKDSK, EDIT, FDISK, FORMAT, MEM, MSCDEX, SCANDISK

Create a directory and store a backup of critical Windows 9x startup files in it. Follow these directions.

1. On drive C, create a new folder called Win-bak.ini.
2. In the C:\Windows folder highlight all of the .ini files.
3. Copy them by pressing Ctrl+C.
4. Click the Win-bak.ini directory, then paste the copied .ini files into Win-bak.ini by pressing Ctrl+V.
5. Using Explorer, set the View, Options to "Show all files".
6. Copy C:\Windows\System.dat to C:\Win-bak.ini (do not drag!).
7. Copy C:\Windows\User.dat to C:\Win-bak.ini (do not drag!)

Research Third-Party Software on the Internet

Create a demo disk of Lost & Found. (Get the demo from *www.powerquest.com*, the PowerQuest Web site.) Execute the demo and print the list of all files that Lost & Found can recover in the root directory of your hard drive.

Data Recovery Services

Research the Internet for professional data recovery services. Report on three companies that offer this service. For each company include the following in your report:

- Name of company
- Contact information, including URL Web site address, mailing address, and phone number
- Short description of their service